THE REFINER AND NATURAL GASOLINE MANUFACTURER

In This Issue

How to Operate on Slender Margins
Bauxite as a Decolorizing Agent
Even the Weed Cutting Roustabout must Know Workings of Plant
Nitrogen Compounds in Petroleum
Panhandle Crude Shows Excellent Gasoline Content
Oil Keeps His Gasoline Plant Running
And many other valuable features.

Vol. 4 No. 9 SEPT., 1925 $1.00 Per Year

Most Profitable For Over Half a Century

For nearly sixty years, service records of tank car operators have established the leadership of "Car Foundry" cars—leadership in Design and Durability, as proven by lowest operating costs and greatest length of service.

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American Car and Foundry Company

165 Broadway, New York
Railway Exchange Building, Chicago
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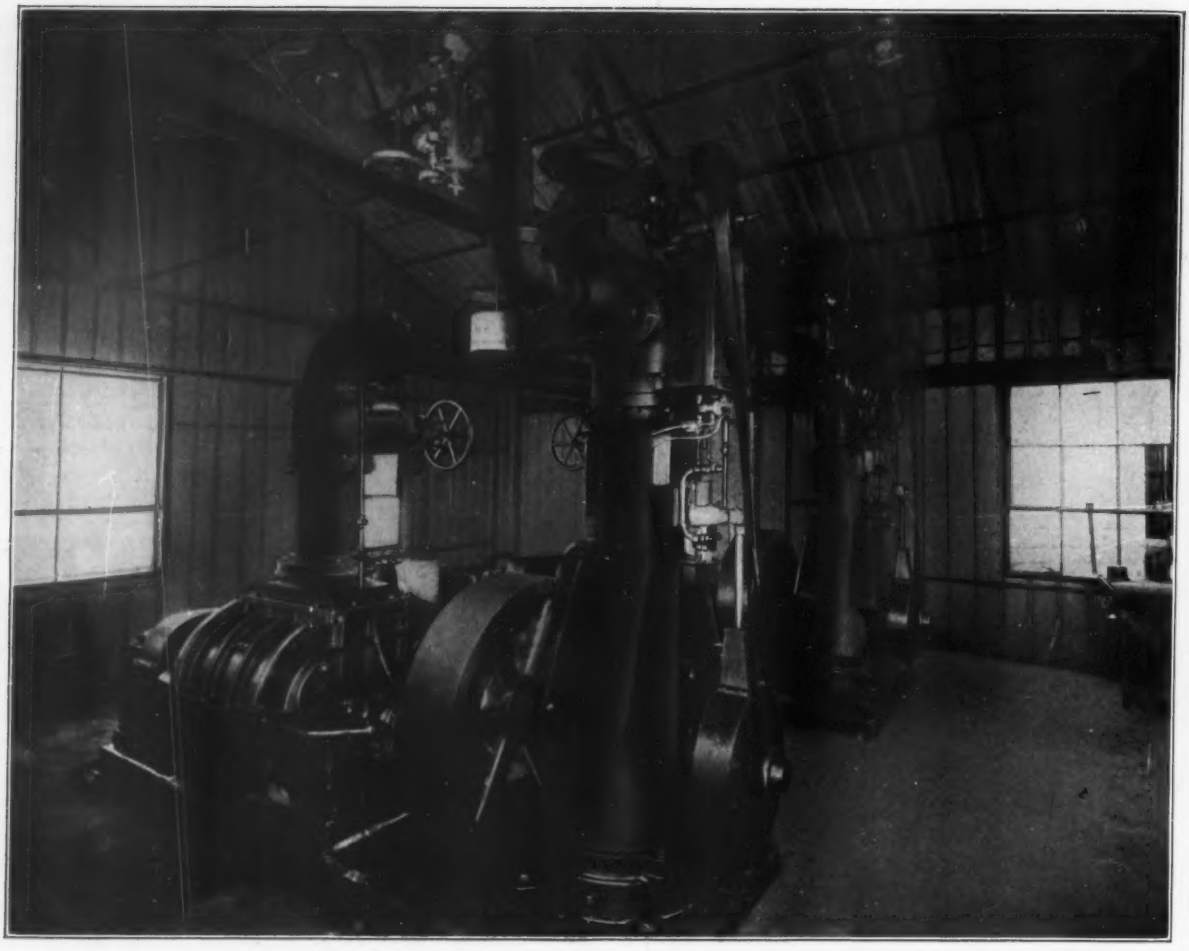
"Car Foundry" Tank Cars



Roots Rotary Gas Pump, size 7, handling gas at the McMann Booster Station, Tonkawa, Okla.

Over 50% of Roots Orders Are Repeat Orders

Many oil companies who are using Roots equipment have sent in repeat orders for additional units. Comar, Barnsdall, McMann, Marland, Sinclair and Skelly are among those who appreciate the advantages of Roots Gas Pumps to the extent of purchasing more equipment.

We will gladly furnish you with sufficient test data to show you why Roots Gas Pumps are ideal for handling uncondensed still vapors and why Roots Rotary Pumps give the most satisfaction in handling anything from gasoline to tar.

Write for Bulletin 108.

ROOTS

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113—Roots Rotary Pumps.

108—Roots Rotary Gas Pumps.

111—Roots Positive Displacement Gas Meters.

118—Engineering Tables.

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DEPT. 10

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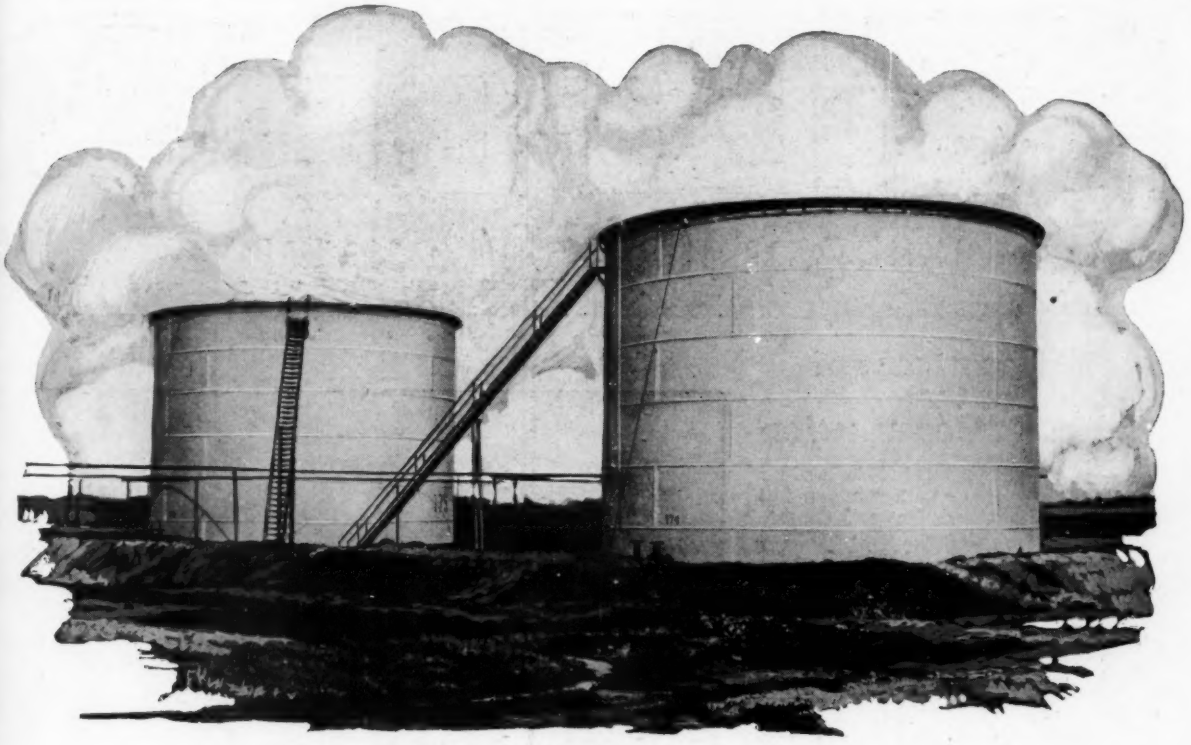

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The use of Degraco Aluminum Tank Paint provides the highest degree of light reflection and the lowest degree of heat absorption that can be obtained by any practical method for cutting down evaporation losses.

Actual field tests have shown that tanks on which this paint is used remain so cool that there is no need to resort to water spraying or other artificial methods of cooling. The result is a saving that amounts to far more than the relatively low cost of painting and maintenance.

Degraco Aluminum Paint is not easily stained by oil leakage — nor is it darkened by hydrogen sulphide fumes as are so many paints when exposed to oil field conditions. The reason for this is that the Degraco Aluminum Paint Formula *provides the right blend of vehicles and pigment* to meet the known conditions of exposure and service.

Send for complete information on Degraco Aluminum Tank Paint including data on tests of its effectiveness in reducing evaporation losses.

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Tank Paints
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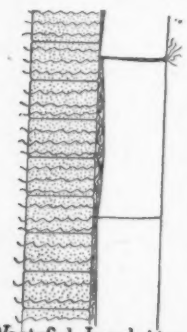
SIL-O-CEL
HEAT INSULATION

The Importance of Contact in Insulated Construction



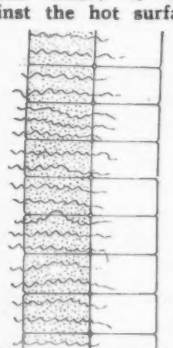
Wasteful Insulation

A half inch of air gap between a hot surface and the material with which it is insulated may mean the loss of half the benefits of insulation.

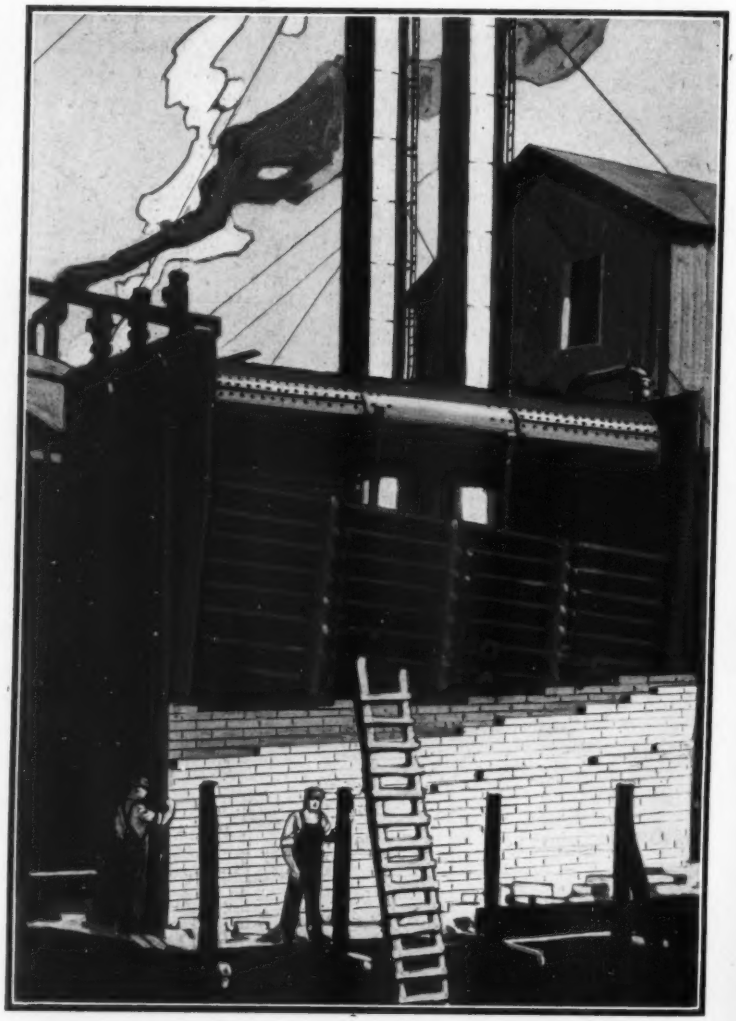
This air space almost invariably finds an outlet, and a direct air current over the hot surface is established. The heat penetrating the walls finds a ready course to the outer atmosphere in this air movement, instead of meeting a barrier to its further passage in an effective wall of insulation.

Insulation which does not "contact" with the hot surface it pretends to insulate is mockery. It can present a cooler surface to the atmosphere and still be much less efficient at conserving heat than insulation that is an integral part of the equipment. The air gap, even if successfully sealed against circulation to the atmosphere, itself can have no appreciable insulating value at high temperatures.

To install insulation where it will serve best—right against the hot surface—costs no more. Yet the importance of insuring a permanent contact in insulated construction is too often lost sight of. It is the business of Sil-O-Cel engineers to call your attention to important details of this nature when you are planning or installing insulation. One is near you. Feel free to call on him at any time.



Effective Insulation



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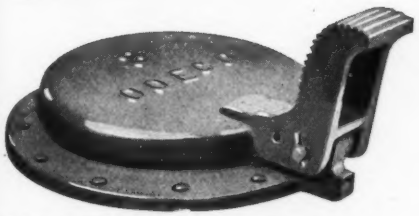
Headquarters *for* Tank Equipment



Gauge and Thief Hatch
Gas-tight, water-tight, spark-proof and affords complete protection in every way.

The reputation for quality of equipment and completeness of line enjoyed by Oceco is the outgrowth of continual investigating, experimenting, testing and developing, backed by a thorough knowledge of the needs of the industry.

Oceco, today, stands for a *complete line of quality* tank fittings.

Swing Joint
Designed and built to overcome all the troubles experienced with old type swing joints.

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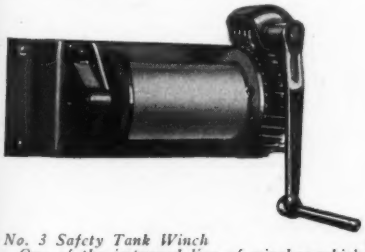
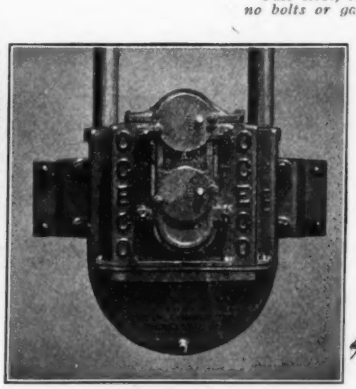


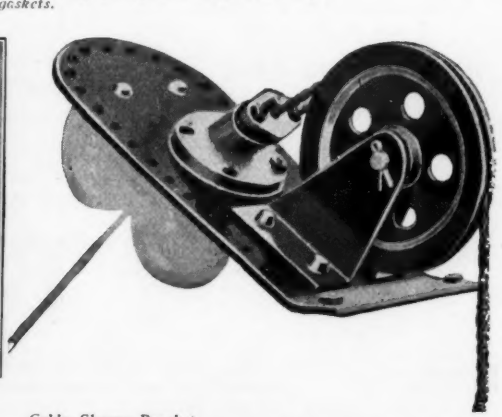
No. 3 Safety Tank Winch
One of the improved line of winches which meets all requirements for swing lines of various sizes, offering the utmost in convenience and safety.

Roof Manhead
Cast steel, self-closing, gas-tight, manhead requiring no bolts or gaskets.

Steel Tank Nozzle
A rigid, one-piece flanged connection through tank shell, providing for attachment of flanged gate valve on the outside and swing joint on the inside.



Automatic Tank Gauge
Will gauge accurately without opening the tank at any point and is read from the ground.



Cable Sheave Bracket
Replaces the old-fashioned windlass housing and its continual evaporation loss and ever present fire hazard.

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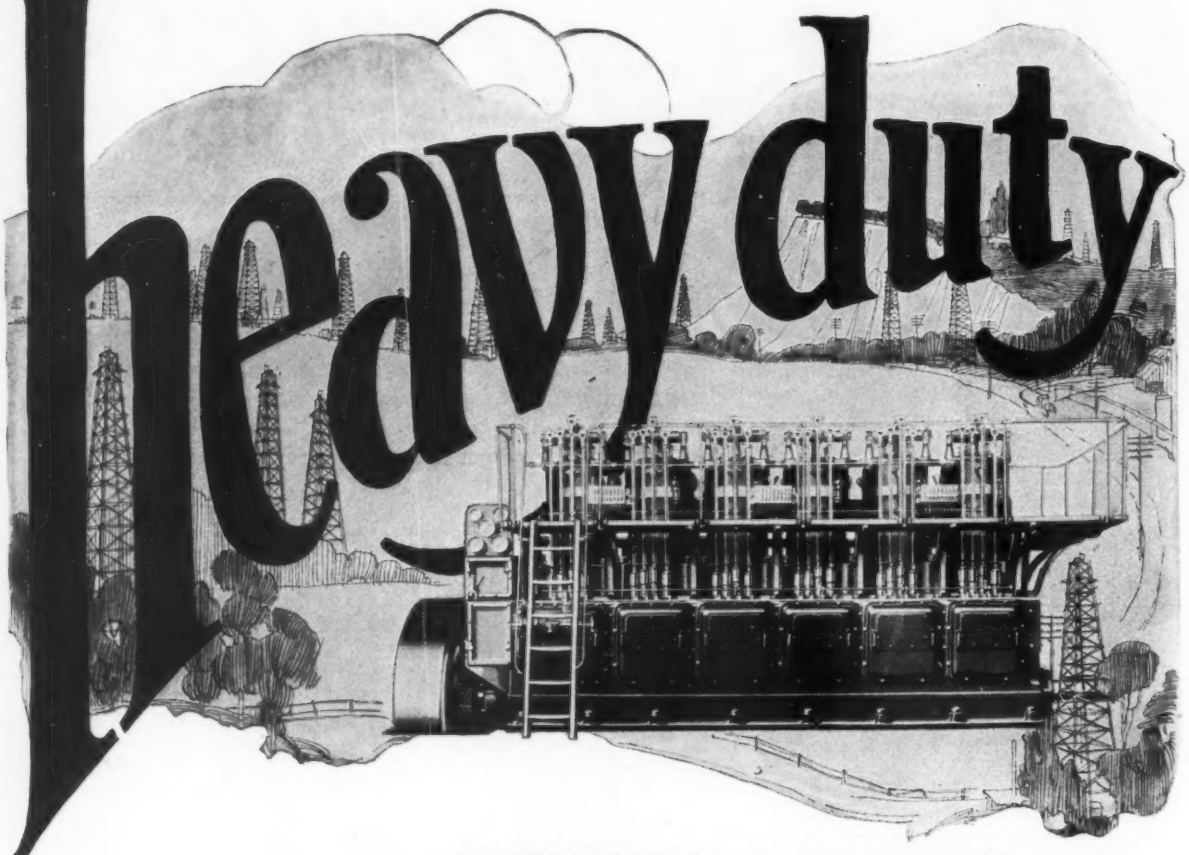
heavy duty



ON LONG-RUN, big load work where you need large units of horsepower, a Bessemer Diesel Engine is a power source of long-lasting economy. Bessemer Diesels are engineered and built for this constant, heavy duty service, and will deliver positive power under constant full load without strain or labor.

From bed plate to rocker arms, Bessemer Diesels are built for the hardest kind of heavy duty. They are built over-strength throughout—with large bearings, crank-shafts, cam-shafts, and long pistons—to withstand years of wear.

For every type of heavy duty service in the Oil Industry a Bessemer Diesel will work harder, last longer and cost you less.

Send for complete engineering details on Bessemer Diesel construction.

they say—

"Constant Full Load never bothers our Bessemer Diesel"

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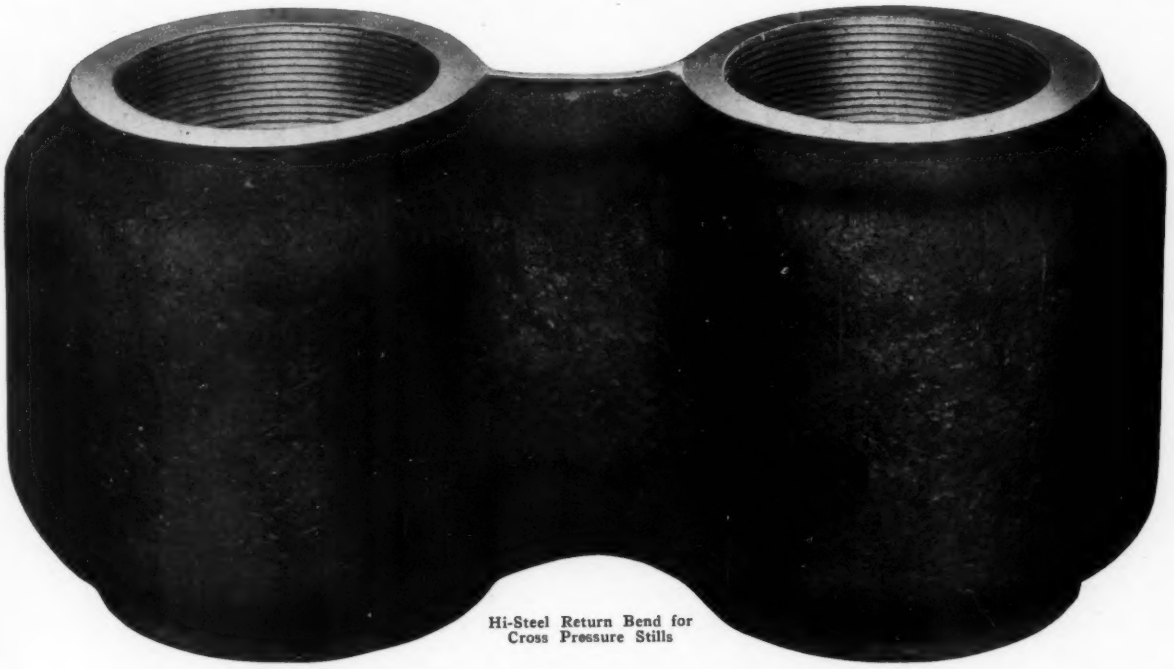
BESSEMER

BESSEMER OIL FIELD ENGINES – COMPRESSORS – VACUUM PUMPS – ROLLER PUMPING POWERS



Hi-Steel Return Bend for
Cross Pressure Stills

HI-STEEL FITTINGS

100 Per Cent Can't Be Improved On

"OHIO" PRODUCTS

Electric Steel Castings
Hi-Steel Fittings
Open Hearth Steel Castings
Fahrite Heat-resisting Alloy Castings
Tank Car Bolsters, Side Frames and Repair Castings.

Three years ago the largest Cross cracking installation in the country was outfitted with nine carloads of Hi-Steel return bends, box elbows and plugs. From the start they have given absolute satisfaction at 800 lbs. and 800° F.

On this record the same company will use Hi-Steel fittings on new Cross units at one of their other refineries.

This same dependability is characteristic of all Hi-Steel fittings and pressure castings.

Write for prices, sending blue prints for special fittings.

The Ohio Steel Foundry Company

SPRINGFIELD, OHIO.

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PLANTS IN
Springfield
Lima

THE HARRISBURG PIPE & PIPE BENDING CO. OF TEXAS, INC.,
Houston, Texas. Distributors for Texas.

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A Picture Done in Oil

That's what the International Petroleum Exposition is to be—a graphic presentation of everything that ever happened in oil. If you are interested in oil you must see it; if not—you should see it, anyway. It's a vivid spectacle.

Oil men from all over the world will gather in a great reunion of friends and comrades, for the Oil Group is a cosmopolitan one.

Something new and entirely unique will be staged this year. There will be numberless attractions—a midway one quarter of a mile long—shows and rides and frolics—a brilliant carnival that will thrill you every minute. Radio artists that you have heard will be here in person; the Pageant of Petroleum will be celebrated with a magnificence that is not surpassed anywhere; the ballets and musical programs are the best to be found; the Pageant of the Princesses will bring beauties entered from all the producing states and, from them, the queen will be chosen. It will be the most pleasurable and profitable outing you ever enjoyed—the viewing of this Great Picture in Oil.

Something new every day—Come prepared to stay for the whole show.

It will pay you dividends on your trip and send you back enriched with recollections of a delightful time profitably spent.

Features

1. The world's greatest radio artists in musical review.
2. Two spectacular parades.
3. Monster midway—21 shows and rides.

Features

4. Daily meetings and conventions in addition to Petroleum Congress.
5. Coronation of Queen Petrolia.
6. The Drake Museum.

INTERNATIONAL PETROLEUM EXPOSITION

TULSA, OKLAHOMA

OCT. 1 TO 10 — Reduced Rates on all Railroads — OCT. 1 TO 10

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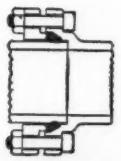
SIMPLEX CAST IRON CONDENSER PIPING



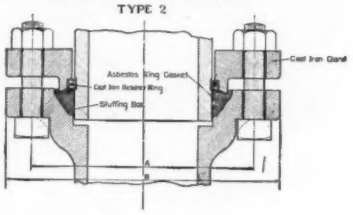
"ONE FLANGE IS LOOSE"

Settles the Rust Question

Progressive refineries now secure the durability of cast iron pipe in their condenser coils without the disadvantage of standard flanged pipe construction. Our Simplex joint, using a triangular shaped, endless asbestos gasket, is the secret. It is fully described and illustrated in our Catalog No. 55. Your copy is ready to be mailed upon receipt of your request.

Do you know why cast iron resists corrosion so much more than other ferrous metals? Our Bulletin No. 44 explains it.

CROSS SECTION OF ASSEMBLED JOINT
SIMPLEX CONDENSER PIPING
TYPE 2



Dimensions A and B are American Standard for 125 lbs. pressure

AREA PER LINEAR FOOT

SIZE	CLASS	INSIDE SQ.FT.	OUTSIDE SQ.FT.
3	AB	.67834	.10175
3	CD	-	.09472
4	A	.10472	.12600
4	B-C	-	.11100
6	A	.15708	.18850
6	BCD	-	.18500
6	AB	.20944	.23600
6	CD	-	.22400
10	AB	.26700	.32100
10	CD	-	.29900
12	AB	.31416	.38600
12	CD	-	.35400

Write for Simplex Condenser Catalog Number 55

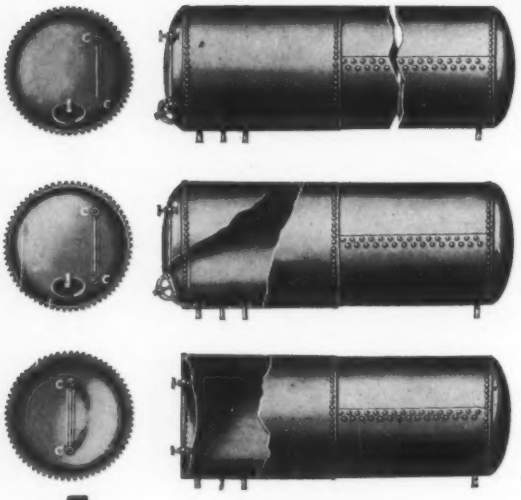
AMERICAN CAST IRON PIPE COMPANY

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York,

Write Also for information on Our Prepared Joint Cast Iron Pipe for Oil Lines

Titusville Steel Hydro-pneumatic Tanks



The Tanks of No Regrets

Built with typical Titusville care and workmanship in a modern shop where only the best of materials are used.

These tanks are all-riveted, tested to 125 lbs. air pressure and guaranteed for a working pressure of 75 lbs.

Special tanks for higher pressures, as well as tanks with special outlets, can be furnished.

Let us send our descriptive bulletin and submit our recommendations covering your requirements.

The TITUSVILLE IRON WORKS Co.
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Oil Country Boilers
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Your invitation–

to see MIDWEST [Joints and Piping]

[**Booth No. 39**
New York Building

Oil & Gas Show
Oct. 1-10, 1925
Tulsa]

THIS invitation is as sincere as if it were a personal letter to you. But letters would enable us to reach only a small number of the executives, engineers, and operators who are necessarily interested in such an important element of the refinery and natural gasoline plant as the piping and its joints.

You will be shown why Midwest Joints are so extensively used on vacuum and high pressure hot lines in oil refineries and natural gasoline plants. The joint is metal-to-metal and requires no gasket—fire hazards are greatly reduced.

You will also learn how Midwest Piping Service has solved piping problems for other refiners and natural gasoline manufacturers. The solutions may be applicable to your own conditions.

Come around to our Booth, and get acquainted—or renew acquaintances. It will benefit both of us.

MIDWEST PIPING & SUPPLY CO.
Second and Miller Streets
St. Louis, Mo.
Tulsa Office: 615 Petroleum Building. Phone 2-3583

Fabricators of Oil Refinery, Natural Gasoline Plant and Power Plant Piping

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COOPER

A Reputation Like This Doesn't Just Happen

United Fuel Gas Co.'s Lewis Compressor Station in West Virginia contains five Cooper Compressors. Two more units of the same size are being added this year.

The United Fuel Gas Co. of Charleston, West Virginia, didn't just fall heir to a reputation for giving an uninterrupted natural gas service. From the man who buys the leases to Manager Harry Wallace, they have all taken pride in doing their individual jobs a little better than usual.

A good many years ago they learned that much of the success of a natural gas company is dependent upon their pumping equipment. An early comparison established Cooper Gas Engines and Compressors as being adapted to their severe and exacting service. Nearly every year since the beginning they have added more Cooper units of both the large and smaller sizes. Today they are operating nearly fifty thousand brake horse power Cooper Gas Engines.

THE C. & G. COOPER COMPANY

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The REFINER
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GRADY TRIPLETT, *Editor*
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R. L. DUDLEY, *President* A. L. BURNS, *Gen'l Mgr.*
Volume 4 SEPTEMBER Number 9

For men engaged in the operating branch of the refining and natural gasoline business

Price.....$1 per year

Advertising rates upon application to nearest office

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How to Operate on Slender Margins

The P. & R. plant at Casper gets a yield of one-fourth gallon from each 1000 cubic feet of gas

By Grady Triplett,
Staff Representative

WHEN the natural gasoline plant of the Producers and Refiners Corporation was built west of Casper, an eye was kept on the fact that it would be forced to operate on narrow margins, especially in the matter of gasoline content. So far as this plant is concerned, it is handling an excellent product when one-fourth of a gallon of gasoline can be extracted from 1000 cubic feet of gas.

This plant is really part of a gas fuel system built by the Producers and Refiners Corporation. It is under contract to deliver 30,000,000 cubic feet of natural gas daily to refining plants of the Midwest Company at Casper. The gas comes from the Little Lost Soldier field, the line being 94 miles long.

With this line operating under contract, the proposition of so constructing a natural gasoline plant that it could be economically maintained on this grade of gas was considered. At times the gasoline content drops below the one-fourth gallon to the 1000 cubic feet of gas. So the construction and operating methods had to be calculated down to a fine point to get within the range of profitable operation.

Well Pressure High

One factor in favor of low cost operation is high rock pressure in the field. No vacuum stations and no booster stations are required. In handling the gas, it is necessary to bring its natural pressure down through regulators before allowing it to enter the absorbers. Some wells in the district have rock pressure in excess of 1200 pounds.

Well pressure is brought into one header in the field and the gas is held back to 350 pounds to the square inch on entering the line. After traveling the 94 miles to the plant at Casper, it has a pressure of 150 pounds. This brought down to 75 pounds, the pressure at which the field gas enters the absorber system. The line from the field's 10-inch.

At the plant it is divided into four 8-inch lines, each of which serves three tanks of the absorber system. The absorbers are the Saybolt type, being set horizontal, each tank being 110 barrels capacity. Each tank is kept half full of Mineral Seal oil, which enters at 56 degrees F.

Flow System

All gas comes in contact with the mineral seal oil in each of the three tanks of an absorber battery. Leaving the absorber system, the gas goes into a fuel line for delivery to the plant of the Standard Oil Company of Indiana for fuel.

Enriched mineral seal oil goes first through the heat exchanger. The heat exchanger has been built to take advantage of the water cooling tower, as its coils extend back into the cooling tower, leaving only the header ends of the heat exchanger coils exposed to view.

Next in its journey, the enriched mineral seal passes into a vent tank, from which the cold oil pump draws

This building houses both the compressors and pumps for the plant

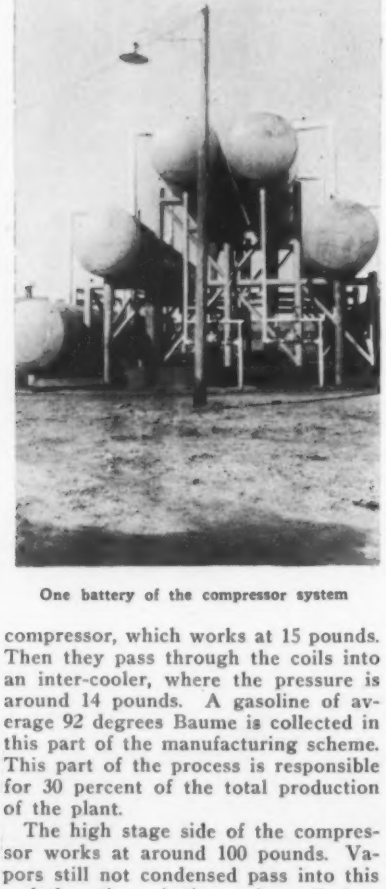
its supply for the two steam stills. Each of the stills has capacity of 320 barrels and is kept about half full of charging stock. A still temperature of around 205 degrees F. is maintained.

Still vapors pass first through the preliminary condenser box at atmospheric pressure. Water vapors are condensed there and drained off. Gasoline vapors then go through water cooled vapor coils and into a pre-cooler, where gasoline condensed up to this point, is collected. Gasoline vapors still uncondensed pass into a second pre-cooler, where more gasoline is collected.

The two pre-coolers collect 60 per cent of the total gasoline produced at the plant. Atmospheric pressure is maintained on these tanks. The gasoline collected has an average gravity of 75 degrees Baume.

Compressors Workings

From the pre-coolers, uncondensed vapors go to the low-stage side of the

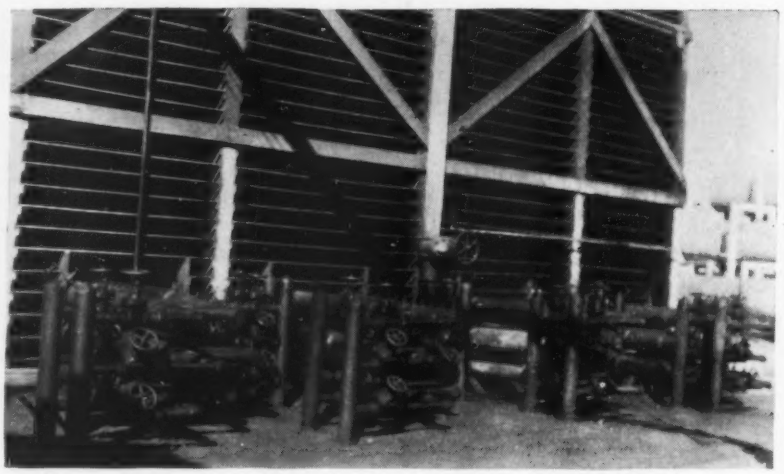


One battery of the compressor system

compressor, which works at 15 pounds. Then they pass through the coils into an inter-cooler, where the pressure is around 14 pounds. A gasoline of average 92 degrees Baume is collected in this part of the manufacturing scheme. This part of the process is responsible for 30 percent of the total production of the plant.

The high stage side of the compressor works at around 100 pounds. Vapors still not condensed pass into this and then through the cooler coils into the after-cooler. Gravity of this part of the output is around 93 degrees Baume and 10 percent of the output of the plant is made in this part of the operation.

Any vapors left in the system are conducted to the boiler house and used for fuel. Two boilers are used. Both exhaust and live steam are used in the stills. All plant power is steam and the two boilers supply this, as well as the heat necessary for stills.



The heat exchanger is so placed that it gets the benefit of the water cooling tower

From both pre-cooler and inter-cooler tanks the gasoline is run direct to storage tanks, no weathering being needed. But that part of the product passing from the after-cooler tank is piped to a weathering tank, where it is steamed down to a more stable product. No use is made of gases from the weathering tank.

Labor Cost Low

One item in low cost manufacture at this plant is labor. Only nine men are required for plant operation, three working at each eight-hour shift. It is possible to operate the plant with few men, largely because of the fact that only two compressors are in use.

Usually only one of these is operating at a time, leaving 100 precent auxiliary equipment. By keeping ample equipment in reserve, it is possible for the few employes to have the reserve equipment always ready for duty, with the necessity of rush work. The men may take ample time for making any repairs and adjustments.

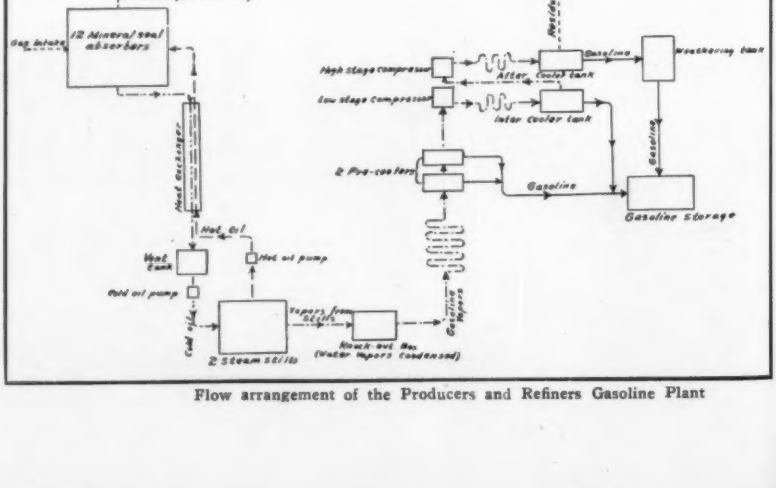
So little work in the operation of the plant falls on the moving parts of the equipment that two men can take care of the bulk of operation during a shift. But three are kept, for there are times when the other man is necessary. A fireman, a stillman and a helper make up each crew.

Always in Reserve

The scheme of keeping ample equipment in reserve, is carried out in the pump house. There are two pumps for circulating water, one hot oil pump and one cold oil pump, with a relief pump for either hot or cold oil. Thus one pump in oil service and one in water service is kept inactive constantly. The plan of operation is to keep a pump in each service idle for a week, during which any repairs and adjustments can be made by the operating force of the plant. When a week has elapsed, the pump is put back in service, throwing another idle for inspection. If this shows need for repairs and adjustment, they can be made.

A similar scheme is used in operating

(Continued on page 24)



Flow arrangement of the Producers and Refiners Gasoline Plant

Bauxite as a Decolorizing Agent

Removal of sulphur odors one of the foremost assets of this filtering material

By Ismar Ginsberg

THE decolorization of petroleum distillates is an important function in the oil refinery. Many filtering agents and decolorizing materials are employed for this purpose. Thus it has been stated that by far the greatest quantity of fuller's earth produced in this country is employed for the purpose of removing the color from petroleum distillates. The decolorizing process is carried out in welded steel filters and the like, which are two well known to require description here. One of the principal considerations in the decoloring process is the percentage of moisture in the decolorizer, as this determines the efficacy of the material to a large degree. Another is the regeneration of the material after it has become inactive.

The use of bauxite in the properly powdered condition for the refining and decolorizing of petroleum oils and distillates is not a very old matter. However, the principles of the bleaching action of such substances have been known since 1896. There have been certain theories advanced on the nature of the phenonena that takes place in the decolorizing action, and it is of great importance that what happens in this process be thoroughly understood in order that the best efficiency may be obtained from its practical operation. The conditions of decolorization have been studied from various angles and different suggestions have been made as to how they should be controlled so that the best results are forthcoming. A recent publication in German, Petroleum, Jan. 10, 1925, contains some matter of interest along these lines which is being incorporated with this article.

What Action?

The important question is, what relation is there between the decolorizing material and the decolorizing action that it has on the oil? Some writers have held that there is an electrical relationship which brings about decolorizing of the oil. Others have held that there is a chemical action that takes place in the process, and that the chemical makeup of the decolorizer is what determines its potency. It seems now generally clear that such is not the case, and that the action of decolorizing is physical in character and that the physical constitution of the bauxite is what determines its filtering potency.

The analogy between bauxite and its action on petroleum and the decolorizing is very close. There may also be mentioned the case of the action of porous earths, silicic acid and alumina on coloring and odorous oils. The use of animal charcoal for filtering purposes, particularly in the manufacture of the so-called filtered cylinder oils, also allows a certain light to be thrown on the action of bauxite in the filtration of petroleum. A study of these filtering media and their action leads to the conclusion that it is not the chemical composition that determines whether a substance is possessed of decolorizing and filtering powers and the magnitude of that power as well, for all these substances are of very different chemical composition, but the physical makeup of the substance. It was just such a conclusion that led to the use of bauxite in the refining of petroleum and its distillates, a substance which is particularly porous and which is employed for this purpose in the finely pulverized condition.

Action of Bauxite on Sulphur Compounds

One of the most important properties of bauxite and the characteristic of this mineral that has rendered it particularly useful in the petroleum industry is its great tendency to combine with organic sulphur compounds. These are the substances that cause the foul odors in certain crude oils and distillates, and their complete removal has always been a source of trouble and concern to the oil man, for in many cases this became a *sine qua non* of their commercial applicability. Experiments have been made with burning oils which possessed a very disagreeable odor. After considerable trouble, a successful process was worked out, and it is understood that the same is being used by the Burmah Oil Company of London. The oil is treated in a filtering apparatus which is made in the form of a tank of eight feet height and six feet in diameter. The bauxite is filled into this tank and the oil is allowed to come in intimate contact with it. After the bauxite has become saturated with the organic sulphur impurities, it is revivified by being washed with benzine. The last traces of benzine are removed by passing steam through the mineral, and then it is calcined in an oven, which is much similar to that which is employed in the roasting of pyrites. After this treatment the bauxite is in condition to be used again in the refining process. It has also been claimed that when the bauxite is employed in this freshly calcined condition, and after its temperature has been raised only to 250 degrees C., not only will it remove odorous substances from the oil, but it will also remove their sulphur content to a considerable degree.

It has been found as well that when the dehydrated bauxite is permitted to cool off and the atmosphere is accordingly allowed to act on it, that its power to remove the sulphur compounds that are present in the oil is considerably reduced. Similar experience has been had with the use of alumina for refining burning oil. One explanation of this phenomena is that at the elevated temperature and when the mineral is in the absolutely dehydrated condition, there is no gas present in its pores and its absorbing power is enhanced. It has also been found that when the bauxite is added to the oil there is a certain amount of heat developed which can only be assigned to the fact that some sort of a chemical reaction takes place between the impurities of the oil and the mineral itself. This would appear to assign the filtering powers of bauxite not only to its mechanical effect on the petroleum impurities, but also to its chemical action on them.

On Different Colors

In the use of bauxite as a decolorizing agent it has been noticed that a much larger amount of the mineral is required to effect a color change from an orange to a lemon yellow than from a black to the orange. It was natural to assign this difference in the action of the filtering medium to that fact that it possessed a different degree of absorptivity for one color than for another. It has, however, been established that it is not a question of selective absorptivity for coloring matters, but a fact that the lighter the color of the oil, the less of the coloring matter will be absorbed by the bauxite. This is a very interesting and important point in the practical use of bauxite in the oil refining process.

Various experiments have been made with mineral oils which have been diluted in the same manner so as to obtain test samples of the same degree of dilution. These samples were then treated with bauxite and the results obtained were plotted graphically. The experiments were made for the purpose of determining the effect of bauxite on the sulphur content of the oils, as well as on the color. It was found

that the substances which give the color to the mineral oil are removed much more quickly than the sulphur compounds. It is only after the bauxite has absorbed the greatest part of coloring matter from the oil that it begins to act in a regular manner on the sulphur content. This fact is of great practical importance, especially in the manufacture of pharmaceutical products from mineral oils, such as vaseline and Russian oil.

Cracked Gasoline

When cracked gasoline is treated with the bauxite decolorizer, the opposite effect is observed. For in this case the bauxite in contact with the fuel induces the formation of gummy soluble polymerized products which possess a boiling temperature which is higher than that of the largest part of the ingredients in the gasoline. Thus when the gasoline is not allowed to filter through cold bauxite, but through the mineral which has been previously heated up to a temperature of 200 degrees C., then there is not obtained a colored and sulphur-free products, as is obtained by the redistillation of colored and sulphur-containing cold filtered gasoline. Hence, in this case as well, the bauxite has a chemical action on the oil, that is, when cold, filtration is practiced, and compounds are formed which are held back only in part, while the remainder dissolves in the gasoline. This is a matter of considerable practical importance.

Another test was made with the purpose of determining if it would be practical to remove the polymerization products, which are formed by first passing the gasoline through bauxite which has been heated to a temperature between 100 and 130 degrees C. The cold filtrate which is obtained from this process is then passed through another cold filter containing bauxite, and the polymerized and condensed products are found to be held back by this treatment and removed from the gasoline.

An experiment was also made on a crude kerosene which contained 0.310 per cent of sulphur. The kerosene was first filtered through a warm bauxite filter bed and then through a cold bed. After the kerosene had passed through the warm bauxite, it was found that the sulphur content had been reduced to 0.26 per cent, and after it had passed through the cold bauxite filter, the sulphur content was down to 0.16 per cent. In this experiment one pound of bauxite was employed for every gallon of kerosene. When the kerosene is filtered through a cold bauxite filter, using an equivalent amount of the mineral, it was found that the sulphur content of the oil was reduced only to 0.21 per cent. This clearly indicates the importance of carrying out a compound filtering process, consisting of a cold and warm filter.

The more one studies the use of bauxite in oil refining, the more it becomes evident that its action on the impurities in the petroleum and its distillates is of a complex nature, and the more it becomes apparent that it is absolutely essential that methodical filtration be carried out. Thus it is a fact that the impurities are contained in the crude oil or petroleum distillate in three states. In the first place, there are the impurities which are suspended in the oil and are found in comparatively large particles. Then there are those which are actually dissolved in the oil, and finally there are impurities which exist in the collodial condition in the petroleum product.

How Used

It is evident that the action of the bauxite on these impurities will be quite different. In fact, it is possible to differentiate theoretically at any rate between three separate filtration zones in the bed of bauxite. Thus the upper zone serves to hold back the impurities that are held in mechanical suspension in the oil. The second or middle zone acts to retain the colloidal suspensions, such as the coloring matters. Finally, the third and lowest zone acts on the sulphur compounds that are found dissolved in the oil.

It has been found in actual practice that it is far better to use a series of small filters than one large filter. By using the small filters the zones of filtering action are divided up into three or more filters, and a better filtering efficiency is gained. For it must be remembered that experiments have established the fact that the sulphur ingredients of the oil will not be removed until the coloring matter has first been absorbed by the bauxite. In a large filter this will occur in the middle zone, but the action will be more complete and more clearly defined when a separate filter is used for removing the dissolved impurities.

There have been some experiments made with Florida earth, either when used alone as an auxiliary filter to the bauxite filter, or when actually mixed with bauxite itself. It was found that the principal action of Florida earth was to remove the coloring matter, and that it was not so active in absorbing the sulphur compounds in the oil. Thus a system was devised in which the oil was first treated with the Florida earth an dthen desulphurized with the aid of bauxite. The results were good, but this was not the case when the earth was mixed with the bauxite. For Florida earth contains a very large proportion of very fine particles, and these particles had the effect of stuffing up the pores of the bauxite, with the result that its filtering and absorptive powers were materially reduced. It is possible, however, to add certain amounts of the earth to the bauxite without bad results, but when these proportions are exceeded, the filtering potency of the mixed filtering medium is decreased.

The Finer the Better

The fineness of the particles of the bauxite is also a controlling factor in determining the effectiveness of the filtering medium. The finer the bauxite, the better its filtering action, but it is a fact that above a certain maximum of fineness the filtering capacity no longer increases, but is actually lessened. Thus the maximum fineness that can be allowed in the bauxite is 30-60 mesh. This is, of course, entirely peculiar to bauxite.

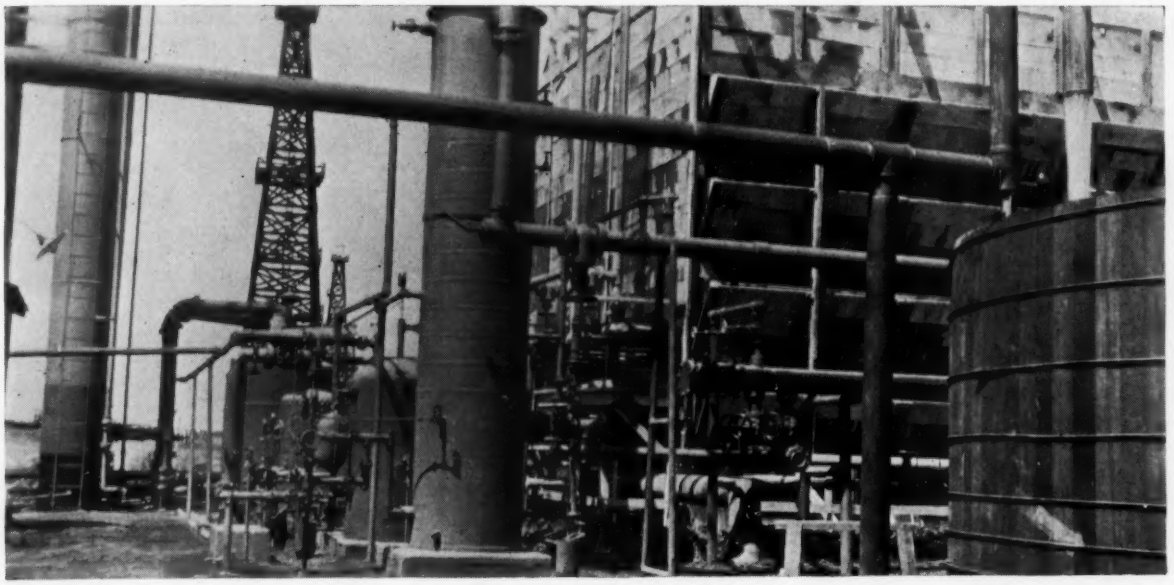
But it is also of importance in the practical use of bauxite to see that it is not too coarse. For if it is, channels will be formed in the filtering bed and oil will seek the path of least resistance through these channels, with the result that it will not remain in contact with the filtering medium long enough to be properly filtered.

Under certain conditions, there is a definite relationship between the shape of the filter and the results that are obtained by passing the oil through it. When viscous products are being treated, the nature of the heating of the filter is also of importance. Then again, in the normal filtering operations when the thinly viscous oils and petroleum distillates are being processed, the form of the filter has no effect on the results.

Two other important factors are the speed at which filtration is carried out and the temperature that is maintained during the process. There appears to be some disagreement on the effect of varying the speed of filtration. It would appear as if the speed had a marked effect on the decoloration of the oils, but it has but litle effect on the amount of sulphur compounds that are absorbed from the oil. There is, of course, no doubt but that if the time of contact between the bauxite and the distillates is reduced too far, the filtering action of the bauxite will not be complete.

Temperature Important

In the case of petroleum products which are but slightly colored or which contain but a small amount of impurities, the temperature that is attained in the filtering process due to the heat of reaction is of slight effect on the filtration results. But it often happens that unsaturated products of an ethylene character are dealt with, and in this case the temperature plays an important role in the filtering process. The action of the bauxite on the sulphur compounds found in the oils, when filtration is conducted at an elevated temperature, is in the nature of a polymerization, and when filtration is conducted in the cold, the action is one of absorption. Then again, a certain definite temperature must be maintained in the filter in order to absorb the water in the bleaching agents in those portions of the filter bed which, as in the case of freshly prepared filters, are not yet saturated with oil. Then again, the manner in which the heating is carried out is also of moment, for when viscous oils are handled, this is a very important matter and determines to a large degree the success of the filtering process.



Every employe of the Pacific Gasoline company is expected to learn the function of every one of the above valves. A hopeless complication, it looks like, but he has to learn the part played by all of them, or the company will "know why.

Even the Weed Cutting Roustabout Must Know the Valves

The Pacific Gasoline Company Finds an Oral Drill Good for Practical Safety

By Wm. V. Gross
Staff Representative

WHY the very idea!

Making a weed-cutting roustabout in the backyard of a gasoline plant take an examination on the working parts of the entire plant. Never heard of such a thing. Why, it's ridiculous!

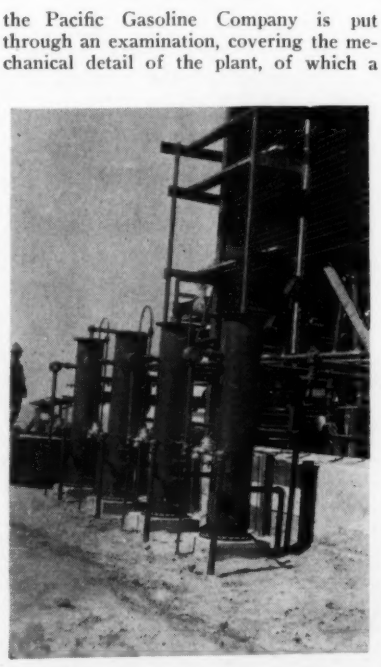
Many gasoline plant operators would laugh at the idea. So does the Pacific Gasoline Company, with headquarters in Los Angeles, California. But it laughs from the good results of the practice, not from the ridiculousness of it.

A concrete example of progress being made in the refining end of the oil industry by these organizations instituting safety measures and of the benefits derived therefrom by both employer and employe is given in a recent step taken by the above company.

Written examinations, pictures and lectures on safety are all very well in their places, according to Kenyon L. Reynolds of the Pacific Gasoline Company. But it is the practical application of means of meeting emergencies and cutting down the number of accidents in a plant which reaps results.

Know the Valves

In keeping with this idea, every man employed in the 24 California plants of the Pacific Gasoline Company is put through an examination, covering the mechanical detail of the plant, of which a working knowledge of all valves and machinery is prerequisite to a passing grade. The examination, which is oral, is given once every three months to each of the more than 300 men in the company's employ, from the greenest roustabout on the premises to the man at the helm of the plant.



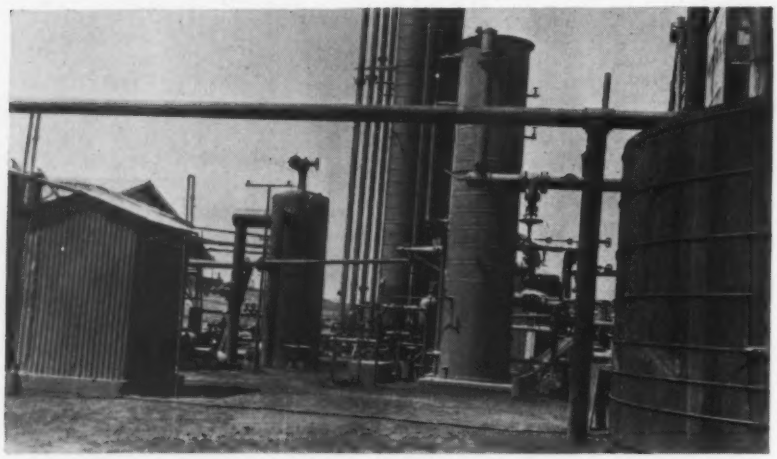
Gasoline and water separators

Questions comprising the test of a man's ability to cope with a given emergency are made up from hypothetical situations. No two examinations are identical. Being oral, the questions are made up more or less at random. The hypothetical conditions are put to the man taking the examination as they are born in the mind of the examiner while he walks through the plant, imagining possible emergencies.

The safety engineer, or one of the company's division engineers, leads one man at a time through the plant, asking him the function of certain valves, the source and destination of conveying lines. This determines whether a man is capable of tracing the path of gas from the time it enters the plant as the raw product until the tested gasoline is turned out.

What Would You Do?

In the course of the examination, the engineer presents a possible situation, and



Another step in the roustabout's examination nightmare. The company's plant at Dominguez

then asks the man being examined just what steps he would take to prevent further damage and to eliminate an impending accident. For example, the engineer leads the man up to a gasoline separator and says:

"Now John, while we are standing here at the separator, let us pretend that that look box was suddenly broken. You know the less important workings of the plant, but what would you do to prevent waste and fire hazard if the box were to become injured suddenly?"

If the man answers, stating he would close certain valves, open others, and take the steps necessary not only to put an end to the present menace but also to eliminate the probability of a resultant accident, he is graded accordingly. If he says he would run, he is likewise graded accordingly.

When the idea of the oral examination first was put into effect, the employes, like most of the good old-timers, were somewhat skeptical as to its real purpose. But when the men realized it was for their own personal safety and mental development along the lines of efficiency in workmanship as well as to save the company money, they fell in line with modern ways. Soon they became enthusiastic, taking a great deal of pride in their ratings as shown by examination grades.

How It Is Done

In order to get around to the more than 300 men used in the company's plants, advantage is taken of the custom in California of allowing all men to change tours at least once a month. This allows every man to be given a daylight examination at least once every three months.

In the operation of 24 plants, there is naturally a certain amount of transferring among the men. A few extra men may be shifted from their regular plants to relieve one of the other plants. And if a man's examination is given in a plant which is new to him, allowance is made for this condition, as the Pacific Gasoline Company builds and assembles its own plants, no two of which are identical. It is expected, when taking an examination in a foreign plant, that a man's grade will fall below normal.

Safety Pays

From the above, it is seen that the system of the oral examination can not but be of advantage to the employe.

How does it pay the company for its trouble?

The idea has not been in effect long enough to permit the gathering of representaive statistics, but it is somewhat significant to note that the company has not experienced a single serious accident, either to an employe or to any part of the several plants, since the institution of the oral examinations. This is an enviable record for an organization operating on as large a scale as the Pacific Gasoline Company does.

"Safety Pays!" That seems to be the company's slogan, and perhaps it explains why it religiously complies with all of the somewhat stringent California safety laws.

New Lunkenheimer Valves Have Many Special Features

The Lunkenheimer Company of Cincinnati, Ohio, manufacturers of valves and engineering appliances, has just released to the market an entirely new line of iron body gate valves, containing many structural features which will appeal to valve users.

The new line of valves is made in two types: stationary stem, inside screw and rising stem, and outside screw and yoke.

The design of the bodies, with their ample thicknesses of metal properly distributed and having large fillets, insure, to the maximum degree, that strength and rigidity essential to withstand the strains incident to expansion and contraction.

All parts are renewable.

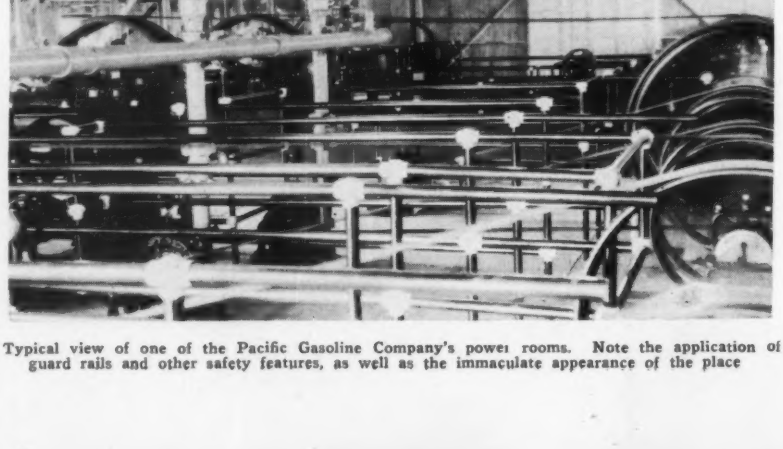
Attention is called to the manner in which the seat rings are held in place. They are solidly backed by the walls of the body of the valve, thereby preventing any possibility of their becoming loose or being wedged out of place.

The ribs which act as guides for the disc in the valve are cast integral with the body and are actually machined, as are also the grooves in the disc which engage the ribs. Naturally, the "side-play" of the disc is controllable by this finishing process, and consequently the disc does not drag upon the seats nor touch them until the valve is fully closed. Therefore, the excessive wear and marring of the seating surfaces incident to the dragging of the disc upon the seats is eliminated and the life of these parts is prolonged.

A large packing surface is provided by the exceptionally deep stuffing box. The stuffing box is repackable under pressure when the valves are wide open—a tight seat being formed between the top of the disc and the bottom of the stuffing box bushing.

One of the novel features is that of the two lugs provided within the yoke arms directly above the stuffing box gland. When it is necessary to repack the valve, the gland is raised above the lugs, and by slightly turning it, the flange on the gland will rest upon these lugs, thereby dispensing with the usual method of tying up the gland while the stuffing box is being repacked.

Copies of an attractive brochure portraying their new line of valves will be mailed to anyone interested, upon application to the company.



Typical view of one of the Pacific Gasoline Company's power rooms. Note the application of guard rails and other safety features, as well as the immaculate appearance of the place

Water the Crux of Gasoline Plant

One of the papers read at the recent convention of the Association of Natural Gasoline Manufacturers

By Emby Kaye
Superintendant Natural Gasoline Department Skelly Oil Company

WATER to the average industrial engineer in Mid-Continent territory means trouble. Water is indispensable, as certainly as it is the greatest single source of grief and concern to the manufacturers of natural gasoline.

In the consideration of the projection of a new gasoline plant enterprise one of the highest officials of our company never fails to ask, "Is there a water supply? Is it good?"

Right here he has hit upon the greatest enemy to the operating end of our business, directly the source of the greatest expense in the operation of our machinery. The Cost of Water and the Repairs, Wear, Treatment and Replacements Due to the Destruction Inherent in Bad Water is Actually Higher than the Cost of Lubricating Oil and Replacements Due to Normal Wear and Tear.

Most of this expense is preventable, but some of it will come despite the most conscientious efforts at upkeep.

Water is used in gas engines as a cooling medium and to some extent in aiding lubrication by direct injection on the one hand, and combustion by humidifying the air, on the other. Translated into steam, it is one of the chief sources of power as well as an aid in the finishing of our product by the injection of live steam during distillation. Natural gasoline in its native state is a vapor, and is a fluid only when it is absorbed by other hydrocarbons or when it is subjected to low temperatures or pressures in excess of atmsophere, or both.

Use of Water

In the manufacture of natural gasoline, whether the absorption, compression, or charcoal-absorption method is used, water is generally the means used for effecting the condensation of the extracted, compressed, or distilled vapors.

In all the various uses to which water is put, we naturally desire a water as free as possible from solids and impurities, whether they are incrusting or non-incrusting. The best condition possible is distilled water, but inasmuch as it is not always economically expedient to provide thousands of barrels of distilled water daily, with few exceptions sources of water are sought which inherently are generally free from the corrosive or incrusting solids, or which can be at least partially neutralized by some inexpensive method of water treatment.

In the Mid-Continent there are three chief sources of water; creeks, dams constructed for catching fair water, and water wells. The most economical supply, naturally, is the creek if it is within reasonable distance from the plant, and occasionally this water will be found satisfactory with little or no treatment. While it may be satisfactory from the standpoint of utility, it is not a reliable source of supply because of the long periods of drought.

This is the rule in the territory comprising the Mid-Continent fields. Then again, it has been our experience to find a stream productive of good water only to see it adulterated by salt water and oil from producing wells in the neighborhood with the result that the supply must be watched with an eye to treatment when that becomes necessary.

In order to take advantage of the seasonal rains good results have in many instances been obtained by the construction of dams to back up the streams in order to make a reservoir, while still in other cases some producers have taken advantage of large water sheds and constructed dams to back up the water at some distance from producing fields where there would be no likelihood of pollution from any source.

Water Supply

In such a case the water would carry in it only those impurities gathered from the air and its contact with the solids that may be on the surface of the earth. The justification of the expense incident to the construction of the dam and acquisition of the necessary land would, of course, depend upon individual cases where the condition of the available supply and the rate of consumption would undoubtedly govern.

One recent example of the development of a water supply by this means was that of the Phillips Petroleum Company in the Burbank field. That company operated several large water stations on Beaver Creek and on the Arkansas River for the development and the operation of their leases and the operation of their gasoline plants.

During the several years of operation with the water supply from this scaling and corrosion. The operation source, unusual trouble developed from of their gas engines was seriously hampered and the efficiency affected, although numerous water treatments were utilized apparently without satisfactory results.

Climaxing their water treatment, they acquired surface rights of a considerable territory adjacent to the field and constructed a large dam which was completed before the present wet season, and although we have had an unusually low rainfall this spring, a mammoth lake now fills the valley and stands ready to supply the needs of the ramified operations of that company with water practically as good naturally as water in the same territory, softened or treated at considerable expense.

This lake should pay annually more than the total cost of construction of the dam and pumping station, not alone in the money value of the water delivered, but in the saving of equipment and diminution of shutdowns due to cleaning and reconditioning engines and condensing units.

Underground Water

The third source, supplied from the drilling of water wells, is one entirely depending upon the structure upon which the plant is situated. In many fields water sands productive of a sufficient water supply occur, and may be utilized by wells either pumped or jetted by air or steam, a detail controlled entirely by the conditions in the particular case. In some fiields water from this source is not available, and in others what is available is of bad quality. At one of our plants a total of 11 pounds of solids were found in every 1000 gallons of water. The mineral solids include silica, iron and aluminum oxides, carbonates and chlorides of lime, carbonates of magnesia, sodium and patassium sulphates, chlorides, carbonates and nitrates.

I believe that this is an extreme case where the saturation of minerals was very high and considerably in excess of what other leases, even in the same territory, will show. The cost of treating this water by any of the known methods would be prohibitive.

Inasmuch as this is a compression plant where water is used only in engine jackets and condensers, this represents one instance where unquestionably a closed cooling system is the most economical solution of the water problem.

Weak Points

The easiest prey to attack in a gasoline plant are the coils and knock-out box, or dephlegmator. The ends of

the coils and headers are the first to become corroded. This is because they are not always wet, but rather wet and dry alternately as the wind and current blow the water as it drops after leaving the sprays. The corrosion manifests itself to a greater extent on the hot end, a fact easily explained because the heat causes this part of the coils to dry more readily.

As it dries, the iron unites with the oxygen from the air and forms rust (ferrous oxide). Where the coils are wet it is more difficult for the oxygen to reach the iron because of the ever-present film of water, and hence the rusting action (corrosion or slow combustion) is retarded.

There are hundreds of different sorts of water treating compounds on the market and we have all fallen victims to several. Our general experience has been that there is no compound for rust prevention for hot coils. Rusting can not be economically prevented on the hot surface without appreciably destroying the heat transfer efficiency of those coils.

A greasy film applied to shut off oxygen practically insulates the pipe and thereby brings about a condition similar to scaling. Moreover, on the very hot ends, e. g., where the vapor comes from the stills, or where the gas enters from the compressors, the unctuous paste will melt off and leave the pipe exposed. The net result is money and time lost.

Distilled Water

The most effective methods of water treatment to retard the corrosive and prevent the scaling action of bad water are by the employment of a water softener, or where the nature of the water permits, an evaporator. In this manner, i. e., by neutralizing the salts (in a softener) or by leaving them in the unused water, (by an evaporator) the scale nuisance can be practically eliminated. The only obstacle to these methods is the initial expense and maintenance cost of the equipment.

All industry, however, is coming more and more to realize that these major investments are justified if they can be eliminated only at a greater maintenance cost of the industrial plant. Certainly if it is cheaper to install and maintain a softener or an evaporator than it is to have to replace coils, knock-outs, cylinders and boilers, more often an evaporator or softener should be employed. It is false economy and poor engineering to keep down the initial investment at the expense of bleeding the income over a period of years by continuous replacements.

The evaporator or water softener will most economically be used in connection with the closed cooling system both for engine jacket cooling and condensers and gas coolers.

Use Economical

The make-up water per engine unit is negligible, as it is the make-up water for the gas coolers and condensers, and as the system is filled with distilled or neutralized water, the work of the evaporators would be confined to make-up water for the boilers and the negligible make-up for the cooling water.

The initial expense and the lack of full appreciation of the enormous saving in maintenance accomplished by this system explains the lack of such installations in this territory.

I venture to say that when the industry is awakened to the possibilities of the closed system, all new plants will be so equipped and present plants transformed where expedient, unless the water is unusually free from mineral matters.

In the present type of plant, where no provision has been made for closed cooling systems, the enormous amount of water that would have to be treated may make questionable the use of either the evaporator or softener. Each plant must needs be studied by itself, and the present expense, volumes handled, and gasoline and revenue produced should all have weight on the question of deciding on an installation.

Paint Necessary

It is my opinion that where raw water is used in an open system there is only one way to protect the coil headers even when using some kind of water treatment, and that is to clean them and paint them with high heat-test paint, if necessary once a week, although once a month will catch most conditions.

While it is true that most paints will come off, yet the cleaning and fresh paint, the smooth surface effected, will retard corrosion. It will not let rust get a "toe-hold" until the next cleaning. Once rust has taken a firm hold, the game is up. If the coils have been neglected for a long time it is probable that the removal of the rust coating will develop a hole and leak. Invariably, when the personnel of a plant is admonished on this score the answer is that it is dangerous to remove the rust as the pipe is so thin that a hole will show up.

However, if rusting has taken hold, the intelligent use of a small hammer will develop the true condition of the pipe and whether or not the same can be scaled and painted, or must be replaced, can be determined. The Paramount Thing is Not to Allow the Condition to Get Out of Control.

In addition to rusting, water causes another evil, previously referred to as scale, caused by the deposit of salts held in solution by the water. The treatment of water by chemical reacting agents to prevent scaling has been found to be more or less successful. Yet, even under the best conditions with the use of compounds, scale will form. Two kinds of scale appear under different conditions.

One form of scale is soft, muddy and massy. In some instances a solution of blue vitriol circulated with the spray water will remove it. The surest means, however, is by the use of a high pressure water hose augmented by a broom. If this soft accumulation is periodically removed, not only will hard scale not form, but a generally efficient cooling system will be noted.

A further result will be a more wholesome appearing plant, free from the foul odors which this slush produces. (It should be added that the mud and dirt and scum from the pit and surfaces of the tanks should be removed, and the water changed as necessity may demand). Too often you will find that the water in the coil pits and tanks is seldom changed. The good water is evaporating all the time while the minerals remain, forming a highly concentrated scale-forming fluid that is really not water.

Hard scale can generally be removed by air hammers or just ordinary hammers. Vibration of the pipe will cause the scale to break off. In other cases, chemical solutions have been found to soften the scale and make it possible to wash off, as previously mentioned. Care must be taken that the compound used only should eat away the precipitation and not affect the rust or iron. Too rapid action and removal of rust often exposes many holes and develops leaks. What is to be aimed at is the prevention of new scale and the removal of scale, not the removal of steel. Although this seems perfectly obvious, it is a difficult idea to get over to some of the venders of anti-scale preparations.

Use of Chemicals

No one would attempt to gainsay the fact that good results have been accomplished by several of the leading chemical companies who are selling chemicals and service in connection with the water treating, while on the other hand quack remedies are on the market. A sort of lethargy has existed with reference to water treatment for this reason. The panacea for the elimination of all water troubles did not perform.

No doubt, a good bit of the trouble is accounted for by the fact that we expected immediate results and 100 per cent improvement of conditions without lending very much co-operation or applying very much care to the proper use and application of the chemicals even after we bought them and paid for them.

Often as not, do we not buy a barrel of chemicals and ship it to a plant where particularly bad conditions prevail and expect the plant to "use it"—without having made proper provision for its use? How many of us have seen so much of boiler compound thrown into the hot pit spasmodically, or so much of a chemical into the coil

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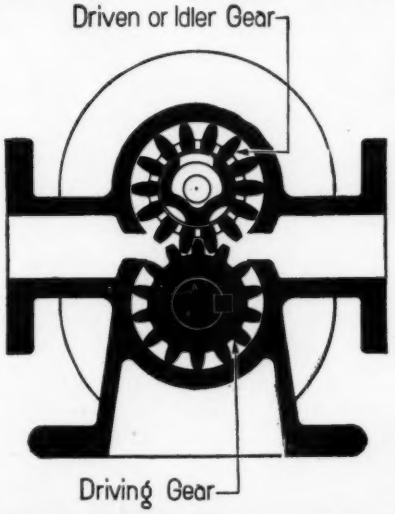

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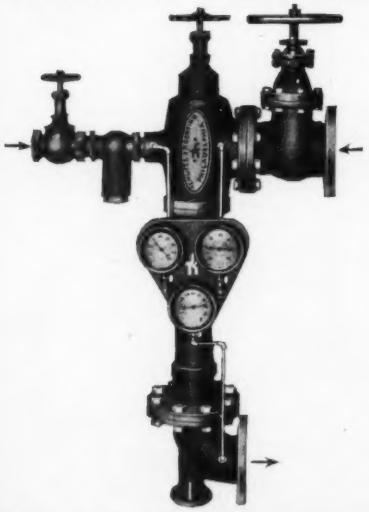

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pit—and then feel we had given the thing a chance and concluded that the darned stuff would not work, only to repeat the process a year later at a different plant, but perhaps with a different chemical from the different concern?

Get a Chemist

If you have not proper facilities for performing the analysis necessary, I should think you would go to some reliable concern that specialized in water treatment. It would eliminate offhand and without formalities those folks who have a remedy without reference to your water. The chances are they have something that will eat away the innards of your equipment and will prevent scale at too great an expense. Then carry out the recommendations of the chemist.

These recommendations will probably be confined to the installation of a home-made water softener. The reason will immediately suggest itself. He will want a tank in which to treat the water so that what salts are precipitated will remain in the tank and not in the circulating system. If you are to treat boiler-feed water, he will want two tanks to be used intermittently. He will want to neutralize the water before it goes into the boiler. This is your crude softener—and you are treating water by the batch system.

This installation is sometimes avoided because the topography of the plant is not such as to permit gravity flow from the treating tank to the system and the general desire to get away from additional pumps, or more often because of the expense of treating. In that event, if it is considered inexpedient to install the closed system, scale is permitted to form, later to be removed from coils as already discussed, and from engine jackets and knock-out boxes by means of an acid or by a widely used chemical designated by a formula of one of the large chemical concerns.

Damage from Scale

The formation of a little scale is not as detrimental to a gas engine as commonly supposed. It may be entirely justifiable to wait until scale has formed to such an extent that heat transfer is beginning to be affected to a noticeable extent before the engine is boiled out.

The danger of this system lies in its susceptibility to negligence, the chance that the cleaning will not be performed until damage has been done. In an organization worth the name, this should not be an important consideration, and with proper supervision this system can be made productive of efficient and economical organization.

In the use of any acid, great care must be taken to see that too strong a solution is not used. The strength of the solution must be calculated on the basis of the thickness and kind of scale to be removed. A 50-50 solution, erally used, as the "acid treating" is usually delayed until the equipment has reached the stage where heat transfer or cooling has been materially diminished by the insulating effect of the scale.

Too much precaution can not be taken to see that the engine water jacket is promptly washed out with water after the "boiling out solution" has been drained. The air coming in contact with the acid, if not immediately washed out, will cause the metal to be eaten out due to oxidation, which is the detrimental reaction of an acid.

The use of so-called "spent" hydrochloric acid in the spray system, after it has been used in descaling engine water jackets, is dangerous, and discouraged. Often as not, the acid is not spent and retaining it in the system, however diluted, exposes coils, sprays, and water pumps to too great a danger.

Constant Battle

In general, the combinating of this natural enemy—bad water—can be overcome or kept in check only by the zealous and untiring efforts of the plant operators in safeguarding the machinery. This effort must be applied in the primary stage, and should be continued unabated at proper intervals during the life of the plant. Otherwise corrosion and deterioration will gain headway and necessitate a capital expenditure for the replacement of spent machinery or equipment long before it has rendered the service to be expected of it.

I have intentionally failed to discuss the saving of exhaust steam around a plant because this is being done almost universally. In some cases, the steam is passed through a closed condenser-evaporator which not only condenses the exhaust steam, but also evaporates some water which increases the supply of make-up water for the boilers and at the same time preheats the boiler-feed water.

In some of the older stations, a crude hot pit serves to preheat the make-up water by passing the steam in under it and at the same time condenses most of the exhausted steam coming from stills and pumps. Water from the knock-out which represents condensed steam injected into saturated oil in the preheater or still, together with water from the waterleg or accumulator tanks, further augment the supply of distilled water for use in boilers.

Boiler Water

Particular stress is laid on the necessity of having good water for boiler use, not only because of the direct and quick harm that can be done on account of scale in the boiler, but because, moreover, of the ineffective operation of stills in which live steam is used with boiler-feed water which causes foaming.

An impure water carried over into the still upsets the operation and causes a product difficult to correct. The amount of water carried over into the still causes the oil and this water to boil instantaneously, and invariably a considerable amount of mineral seal oil is carried over into the vapor line and ultimately into gasoline storage, because the knock-out box or dephlegmator, being overtaxed, cannot take care of all the excess oil, and permits it to go through with the gasoline vapors.

Electric Method

There has recently appeared in this territory a new method of scale prevention known as "Anti-scale," in which an electric current generated by a thermodynamic cell, is the agency. A battery of the size required by the particular piece of equipment is connected to the exhaust, in the case of a gas engine, and to the steam outlet of a boiler for the purpose of providing the necessary heat for the generation of the electric current, and the terminals are connected by means of electric cords to the engine or boiler, as the case may be, so that all of the equipment will come within the range of the generated current. In the case of a boiler the terminals are connected to the blow-off line and to the water inlet, while in a gas engine the water intakes of the compressor and engine are used. In this way the engine jacket and the boiler shell and flues lie in the area through which the current must needs pass.

It is contended by the licensees of this antiscale equipment that the current of so many miliamperes set up and present on the water surfaces make for a reversal or neutralizing of the process of corrosion. The current creates a back pressure behind the scale and removes it, and from then on prevents the adhesion of new particles of scale on the hot surfaces. Inasmuch as results were guaranteed and installations offered to be made without cost, it was not necessary for any of us to run any risk with these experiments, and because no expense to us was involved we were not as much interested in the theory and pretenses of the vendors of the equipment as much as we were in the results.

Results Count

Nor am I now interested so much in the cause and effect as in the results which we have experienced in our own plants and in what we may reasonably expect in the future. We have permitted one of these installations in several of our plants on both boiler batteries and gas engines and I am constrained to permit our own experience to guide us in the future. A five months' experience has shown us that under varying conditions of operation, where we have been in the habit of expecting scale in our boilers and where we were obliged to clean our boilers every ten days, we have found that this equipment has absolutely pre-

(Continued on page 44)

Oil From Shale Will Require Double Manufacturing

Government now installing experimental station on naval reserve in Colorado

By Grady Triplett

Denver, Colorado.—With the Bureau of Mines entering into the extraction of oil from shale, interest in this source of crude oil is being revived through the Rocky Mountain area. Work has just started on the one retort the Bureau is to operate on shale from Naval Reserve No. 1. The retort is to be erected on land known as Naval Reserve No. 3. It will be near the railroad station at Rullison, Colorado.

Officials of the Bureau of Mines are laying emphasis on the fact that the retort is being installed for experimental purposes only. The one retort will not give enough oil to enter into use for naval purposes or for any other use in commerce. But sufficient oil for experimental purposes will be produced. The supply will be sufficient for running through experimental stills.

So the installation will give a double line of experimental work under auspices of the Bureau of Mines. First will be the manufacturing of crude oil. The second will be the refining of the product manufactured.

Type of Retort

The retort to be installed is known as the Pamberston type Scottish retort. Excavation has begun and it will take upwards of a year to complete all work necessary to the mining and retorting of the shale. An expert from Scotland will be in charge of the construction of the still and may be retained for operating it.

There are a number of shale retorting methods under American patent, some of them having installations in Colorado and other Mountain States. Some of these installations are on commercial size, while others are in cities and are for experimental work only. But only a few concerns ever have been able to maintain consistent operation of an oil shale retort in the Rocky Mountain area.

Many causes have been advanced for this. The foremost one is that the cost of producing oil by this method is too expensive for competition with oil produced by pumping or flowing from wells. There are other reasons.

Shale Values Known

Still interest in the extraction of oil from shale has been growing in recent years. This interest is based on extensive study for men of long experience are giving their time to the study of oil from shale. The result is that the greater part of the shale beds of the Rocky Mountain area are under ownership and lease to individuals and concerns, whose intention is to take out the oil.

No doubt exists as to the possibility of oil from shale. The paramount question is the method of extraction, a problem the Bureau of Mines is now undertaking by the installation of this retort.

Whatever the method adopted for retorting oil from shale, this gaining petroleum products from shale involves a double manufacturing problem, where crude oil from subsurface sands offers but one cycle of manufacturing. Oil from shale must be extracted through retorting, that is one course of manufacturing. After getting oil from the retort, the oil must be handled by refining methods, perhaps identical with those now in use on crude oil.

No Oil In Shale

Contrary to the common opinion, crude oil does not exist in shale. Instead the ingredients of crude oil, hydrogen and carbon, exist there. So the retorting of oil from shale is one of combining the ingredients to form crude oil.

This is explained by Victor C. Alderson, president of the Colorado School of Mines, in one of the Quarterlies of that school, as follows:

"True oil shale contains virtually no oil as such but it does contain carbon and hydrogen in the organic remains. Since carbon and hydrogen are the main chemical constituents of oil and gas, a proper distillation of oil shale, that is in an air tight retort at a temperature of approximately 800 degrees F., produces oil and gas. Thus shale oil becomes a manufactured product."

In this same publication this author gives the following on the manufacturing of oil from shale:

"The oil shale industry is not a poor man's game nor a one man game. It is not like high grade gold or silver mining wherein the ore can be shipped to a smelter, nor yet like placer mining wherein the miner gets his daily wage in the rocker, sluice box, or the gold pan. Rather it is a highly complex undertaking that requires large capital, extensive technical ability and thorough organization. In detail: land must first be acquired, assessment work done and patent secured; then the property must be opened, mining equipment installed, and development planned for a daily production of 1000 or more tons; conveying and crushing machinery are needed to prepare the shale for the retorts; the retorting of the shale becomes a chemical task in which the problem is to produce a light high grade crude oil in large quantities at a low price; this is to be followed by a refining process to make marketable products such as gasoline, lubricating oils, wax and possibly ammonium sulphate and other products; then the spent shale must be disposed of; finally there is needed a selling organization to market the products."

Retorting Methods Known

Failure to take into account all the steps outlined above is charged with the spasmodic success of some of the concerns essaying the task of taking crude oil out of shale. Regardless of what has happened in the past, it is logical to conclude that oil from shale will reach extensive proportions whenever economic conditions are in favor of the investment to produce the oil.

Nothing in the process of retorting oil from shales is unknown to science. As for converting this shale oil into gasoline and other petroleum products, the process will be similar if not identical with modern petroleum refining.

On this point C. A. Fisher wrote as follows in his paper, "Our Future Oil Reserves," before the 1925 session of the American Association of Petroleum Geologists:

"The basic principles involved in the retorting of oil products from shales have been employed in commercial practice for many years. In this country, however, because of the abundant supply in the past of natural petroleum which met our requirements, American technicians have confined themselves more particularly to experimental and laboratory research with the purpose of improving the plant efficiency of commercial distillation processes used in foreign countries. The oil produced from the oil shales is not present in the form of liquid but as kerogen (resins) from which an oil is produced by heat through a distillation process. Much has been written on the retorting methods that have been devised. However, a survey of the numerous methods employed in the United States shows that there is one commercial plant in operation and several other

methods have passed the stages of experimental work—some of the latter appear practical and are awaiting the construction of commercial sized plants before further comment is made."

What Shales Yield

Further this author had the following to say of the quality of oil from shale:

"The shales of the western states may be said to yield in the main paraffin base oils, which are readily cracked into the various petroleum products, ranging through gasoline, kerosene, lubricating oil, fuel stock, paraffin wax, tars and greases. In a long series of tests conducted by the United States Bureau of Mines and the State institutions in Colorado and Utah it has been demonstrated that the liquid condensates there may be secured about 30 percent of straight run gasoline, however, the oil from shale is obtained by a manufacturing process and therefore the products and by-products recoverable are, within chemical limitations, at all times under the control of the operator. Recent developments in cracking processes indicate that the percentage of gasoline recoverable may be greatly exceeded if desired."

So far as the several methods of retorting are concerned, it is not the purpose of this article to go into the merits of any of them. Doubtless excessive claims have been made for some processes. In other instances retorting methods have been hampered by too little capital. In still more numerous instances, perhaps, lack of knowledge has been responsible for lack of success.

But it is known that some of the patents on retorting offer successful methods of robbing shale of oil, which can be converted into the several products of petroleum. With such processes available, the restricted use of these must be charged to some other cause

Here anyone studying shale oil runs into the economic phase of the matter. All sorts of conflicting figures are available, some showing that oil can be retorted from shale as cheap as it can be taken from sands below the surface in the form of liquid. Still other figures show that the excessive cost is responsible for lack of the use of retorting in taking oil from shale.

Belongs to Oil Industry

One condition seldom taken into account in considering the status of the shale oil industry is the connections of the concerns that have undertaken the work. Too often these concerns have been launched for no other purpose than to mine shale and extract oil from it. As Dr. Alderson pointed out in his paper, the part quoted earlier herein, the successful handling of oil from shale involves refining and sales just as much as it does mining and retorting shale.

So it seems a safe conclusion to warrant the prediction that the development of an industry in the mining and retorting of shale will be in the hands of the present oil industry. Except in the matter of protecting themselves through the acquiring of shale deposits, little has been done by the petroleum industry in this matter.

But the industry now has an investment of $12,000,000,000. That subsurface formations do not offer an everlasting source of oil is known. So it is but a matter of protection for the present oil industry to protect is future existence by delving into shale as a source of raw material.

When that time comes, the petroleum industry will have to deal with a double manufacturing problem. First the oil must be manufactured in retorts. Next the products of petroleum must be manufactured in stills and other refinery equipment.

There is nothing in the Rocky Mountain region to indicate any sudden turn toward shales on the part of the petroleum industry. But shale deposits and retorting methods are certain to have the consideration of the petroleum iidustry when economic conditions warrant.

Superheated Steam Handbook

Superheat Engineering Data, a handbook on the generation and use of superheated steam, has recently been released from the press by The Superheater Company, New York City.

This handbook contains condensed data for steam power plant engineers and operators. A feature of the book is the index consisting of 16 pages, assuring ready reference. Superheated steam, its advantages over saturated steam, and the proper design and performance of superheaters, are briefly discussed. It illustrates superheater arrangements in practically all stationary, marine and locomotive type boilers commonly made in America. Waste heat, portable and separately fired superheaters are also shown. Brief comparative data is given as to sizes, tube sizes, arrangement of tubes, etc., for the stationary water tube boilers illustrated. The steam tables cover pressures from below atmospheric to 600 pounds absolute, and include properties of superheated steam from 50 to 300 degrees F. superheat.

The section on piping includes information for figuring piping for handling water, saturated and superheated steam, and velocity and pressure drop of water and steam flowing through piping. In this section is included also the proposed American standards for high pressures. Superheat Engineering Data also contains engineering data on coal and oil fired boilers, which include tables of heat values for gaseous, liquid and solid fuels. Other miscellaneous data include complete conversion tables and data on bolts and screw threads with the recent work of the American Engineering Standards Committee, and the National Screw Thread Commission. There are also many miscellaneous tables frequently used by steam engineers.

Further information concerning the book may be secured from the company in New York.

How to Operate on Slender Margins

(Contined from page 14)

the two compressors. One is kept idle for a week, then put in service, while the other has a week of idleness.

Each compressor is a twin-stage, 64 horse power, with 16-inch stroke. The low stage side has cylinder diameter of 16 inches, the high stage being 8½ inches. Compressor speed is kept close to 100 r. p. m.

Water for boilers, jackets and for cooling comes from the North Platte river, one and one-half miles away.

Discharge gas is measured in two lines. One line goes to the refining plant of the Standard Oil Company of Indiana for fuel, an orifice meter being used for this measurement. A small part of the residue gas goes to a small town, Mills, for domestic use. A proportional meter measures this gas.

An orifice meter is used for measuring the gas as it comes into the plant.

Studded Steel Posts For Fence Building

Kokomo studded tee steel posts are said by their manufacturers to be a long step forward in the development of steel fence posts. Strength and durability are the outstanding characteristics.

The sturdy reinforcing rib running the full length of the post adds greatly to its strength. The way in which the anchor plate is attached to the post also insures maximum strength: the plate is attached by the simple process of flattening out two of the post studs that come through the openings in the anchor plate.

Ease and strength with which Kokomo posts can be set are additional points in their favor. It is claimed that one man with a helper to hold the posts can drive from 200 to 300 posts in a day.

More information will be supplied by the Komo Steel and Wire Company, Kokomo, Indiana.

Heat Exchanger Bulletin

Heat Exchangers for Oil Refineries are fully described in a bulletin recently published by the Schutte & Koerting Company, Pittsburgh, Pennsylvania.

Exchangers manufactured by this company vary in size, with 25,000 gallons of oil per hour as the maximum capacity. Figures taken from estimates made at one refinery where Schutte & Koerting Exchangers are in use, show that the use of these exchangers increases the output of the stills 20 per cent.

Copies of bulletin No. 12-H will be sent to anyone upon request.

Dubbs Order Increased

The Universal Oil Products Company of Chicago has announced an order of six Dubbs cracking units for the Shell Company of California. The company first ordered two units.

Oil Keeps This Gasoline Plant Running

Crosbie & Gillespie believe in free use of lubricant to escape excessive repairs

LUBRICATION is just one item in the care of natural gasoline plant engines but it is such an important item around the plant of Crosbie & Gillespie near Kiefer, Oklahoma, that other items play minor roles.

Before giving some of the details of the lubricating methods prevailing at this plant, it may be well to give the record of the plant. The plant was started November 29, 1913, and it has never been completely shut down since that date.

In that time, parts of the equipment have been down for brief periods but

One of the filters that reclaims drip oil

the plant has been making gasoline each day since it was put in operation. The plant, one of the old compression units of Oklahoma, has been enlarged several times. There are now two separate buildings.

The whole equipment consists of 32 Bessemer engines, direct connected to compressors. The nine vacuum stations are equipped with 26-20 Worthington pumps. These engines have been bought over the period from 1913 until the present. Two of them have been running eight years without ever having a wrench on them.

And proper lubrication is credited with keeping this equipment operating in this manner.

Oil Used Freely

But right off the story turns from the expected to the unexpected, for lubrication is not done by rule and chart. The engines, compressors and pumps are oiled at the plant and not from the office. This is contrary to practices with many concerns, where lubricating oil is stored in a central warehouse distributing it to gasoline plants in equal quantities, at regular dates. This gives a plant lubricating oil for a fixed period. This method is adopted for the purpose of regular and consistent lubrication and for the purpose of saving oil.

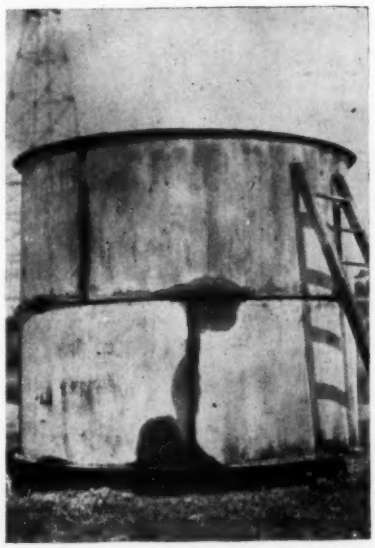
But in the case of Crosbie & Gillespie, lubricating oil is shipped direct to the plant in tank car lots. It is unloaded into storage tanks, from where it is piped into the buildings that house the engines and compressors. The plant operators under this scheme have no restraint on the amount of oil to be used.

No Two Alike

The theory under which the equipment is lubricated is that no two engines or compressors are identical in their oil demands. One engine may require more oil than another, although the two are identical in type and size. No effort is made to explain that around the Crosbie & Gillespie plant. From experience it is accepted as a fact.

The amount of oil an engine needs is left to the judgment of the engineer. He is on the job. He should know better than any other person when equipment needs oil. So it is left to him to supply the oil.

If one engine is in the class of a movie star, having temperament in the way of oil demands, it is given what it



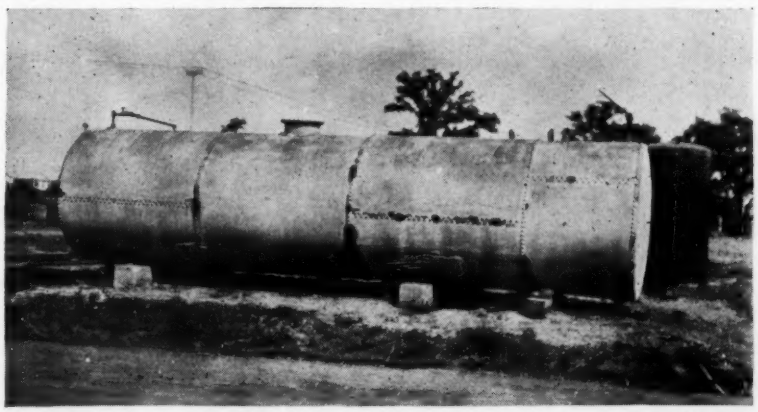
The horizontal tank for lubricating oil storage

demands, although its fellow actor may be of the plodding understudy type, willing to do equal work on less oil.

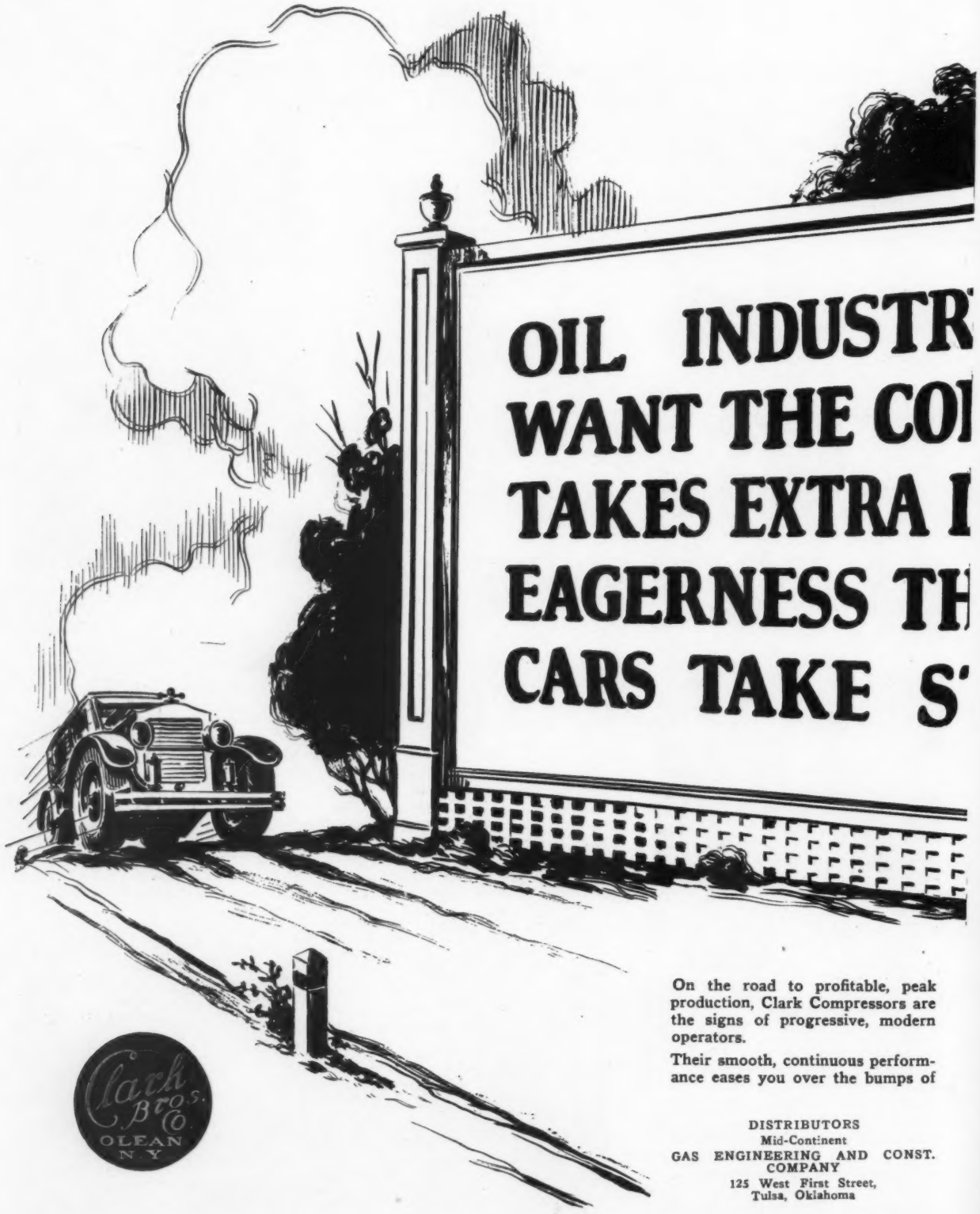
Oil Cheap Item

Oil around the Crosbie & Gillespie plant is considered the cheapest product that can be put on an engine. It is supplied in quantity and user as freely as the engineers deem necessary.

Instead of oil being supplied to the plant from some central source, the plant of Crosbie & Gillespie is the central source. For the owners, having other interests in Oklahoma, draw on the Kiefer plant for oil. It is shipped from there to



Lubricating oil drains by gravity from this tank into the plant buildings



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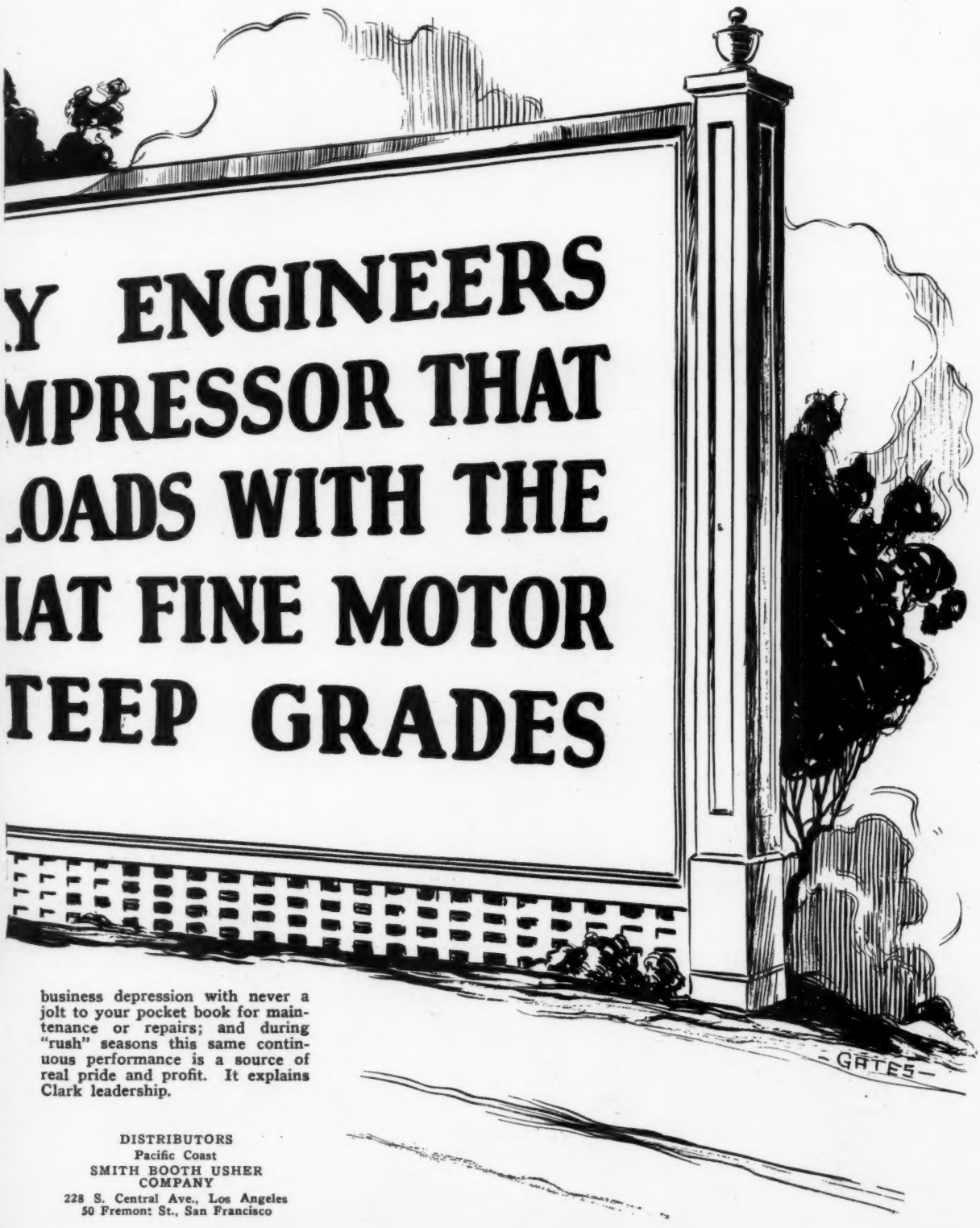

business depression with never a jolt to your pocket book for maintenance or repairs; and during "rush" seasons this same continuous performance is a source of real pride and profit. It explains Clark leadership.

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oil leases and other plants as the other places need it.

But where this practice is followed, no check is kept on the amount of oil used daily at any one spot. The oil needs are determined by the man on the ground.

The theory on which this concern buys and uses oil is that proper and consistent use of oil is as equally as important as the sort of oil used. This company uses the Conopus oil of the Texas Company. It is a gas engine oil of light grade and has been used over a long period.

Stored at Plant

Shipments are made in tank cars to the siding of the gasoline concern at Kiefer. Two tanks on the plant lot, one horizontal, the other upright, are used for lubricating oil storage. The tank cars are unloaded into these tanks.

Pipes from these tanks run into each building of the plant. These pipes discharge into metal barrels, equipped with floating valves, which keep the oil level uniform in the barrels. Flow from the tanks into the barrels is by gravity. To accomplish this flow, the tanks are at a slight elevation. In cold weather, slight pressure is put on the oil tanks to force the oil into the barrels within the plants.

The engineers fill their oil cans from these barrels, drawing the oil as often as they decide to use oil. That process goes on throughout the day and night, the engineer paying no attention to the amount of oil he has used. His one concern is to keep the equipment properly oiled.

But this must not be taken as evidence that the concern and its employes are wasteful. Quite the contrary, for both plants are equipped with filters and drip oil is saved religiously. Pans are in evidence at every point where oil will drip. These are emptied into the filters that are a part of the lubricating equipment.

Each plant has a Cross Oil Filter, manufactured by the Burt Manufacturing Company.

Drip oil and cylinder oil are put through this filter and then used in crank cases. When crank cases are drained, this oil also is filtered. But drip oil or oil used in any other part of the equipment is never used for cylinder oil. Only fresh oil is put in the cylinders.

Without some calculations, the Crosbie & Gillespie concern could not give the cost of lubricating the Kiefer plant.

But executives of the concern do know that repair bills are so low they are negligible. And the free use of lubricating oil is considered the real cause for this.

What About the Boiler?

In a certain boiler room of a Mid-Continent refinery, there is this warning:

IN GOD WE TRUST
BUT
KEEP TWO GAUGES OF WATER

In other words, the boiler is a good old work-horse and not given to frequent displays of temperament but treat it well just the same.

Down at the Hanlon gasoline plant No. 2 near Breckenridge, Otto Peters, the superintendent, has a plan of gathering his men together for little talks on plant operating methods.

The accompanying article is what he had to say regarding boiler care and operation. Like the Mid-Continent refiner, he looks on the boiler as a piece of equipment that will go on giving good service day after day but it needs attention now and then, just as other equipment needs attention.—The Editor.

THE changes taking place in gasoline plant operation in recent years have developed many new parts of apparatus, such as stills, heat exchangers, reflux towers, absorbers, cooling devices and recording apparatus. We plant operators find it an interesting study to keep up with these things. We try hard to find out how they function and try harder to make them function properly.

Through it all we seem to ignore the importance of one piece of apparatus so simple that it is easy to pass up, yet a dangerous device and one I feel sure plays a most important part in our plant operation. It is abused, neglected and misunderstood, on the other hand it is a device that enables a man to demonstrate his forethought and economy.

Its function is to convert water into steam under pressure greater than atmosphere. It is called a boiler, and surely you agree with me it plays a vital part in our plant operation. I remember how I used to cuss the boiler. I also recall my fear if it, but I have learned to treat it with due consideration.

What to Look For

In studying the boiler I found that in selecting one we must look at the joints, either lap or butt or strap joints, the spacing of the rivets, the rivet heads, the plate edges and condition between rivets, excessive caulking marks, hammer marks, tube spacing, the beading of tubes, the tube ends to see whether a roller or expander has been used, to see if the tube sheets are flat and not irregular surfaced, the braces must comply with the boiler code, the support lugs, the flanges, the manhole seat and cover, etc., all these things enter in selection of boilers.

In operation of a boiler I find it covers installation, running, care and repair. We must figure its proper location, the boiler house must be looked after to make sure it provides proper draught to all boilers, proper location of boiler assists in layout of piping.

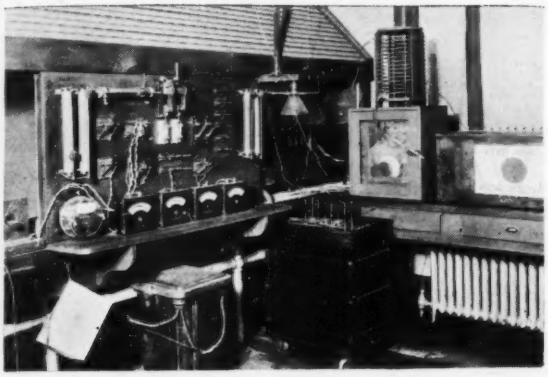
What heed are we giving in getting up steam? How do we start the fire? One of my men not only blew off the fire-box door but nearly blew himself up. What precautions do we take? What should be done before steam begins to form? Do we open the pet cocks to let out the air? What attention do we give the water gauge? Is the level indication true. What indication does it give that it is not working? How should water feed to the boiler?

What is priming, foaming, and what causes it? We have to keep in mind corrosion, pitting, scale formation. How do we handle the blow-off valve? What methods do we use in washing the boiler? How many of us know how to make emergency repairs? How do we install and repair flues? How about height of smoke stack? In taking down a boiler do we protect it and its parts?

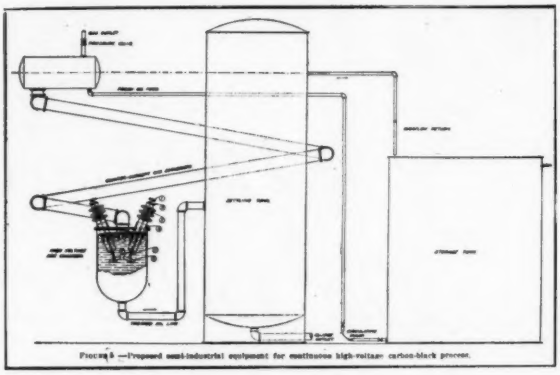
Dangerous if Mistreated

I found the injector an interesting device, it creates a vacuum to suck in water and then discharges it into the boiler under the boiler pressure, this is indeed peculiar because it is affected by water temperature and at times the boiler pressure. I found there is a right way to put on the boiler gauge. We have to keep in mind the safety valve, and the condition of water gauge cocks, the fuse plug. Have you considered the importance how far it sticks into the crown sheet? We have to allow for expansion of boiler on setting, we have to know how to heat in a boiler but it is almighty important to know that the boiler is a dangerous device in the hands of an inexperienced man.

There is wet steam, dry steam, superheated steam, the importance of maintaining steady boiler pressure is not to be ignored. Its effects are reflected in the operation of our steam stills and separating tanks. There is the matter of preheating water feed to boiler. How about handling of water feed pumps? How do you protect the crown sheet side walls and mud rim? In shutting down the boiler do you protect it against vacuum? I was told a boiler in operation acts like a sponge, it's continually breathing. I want to remind you of one other thing and that is, have you considered what parts of a boiler are unsafe to weld?



Apparatus used in studying the electrical cracking of hydrocarbons



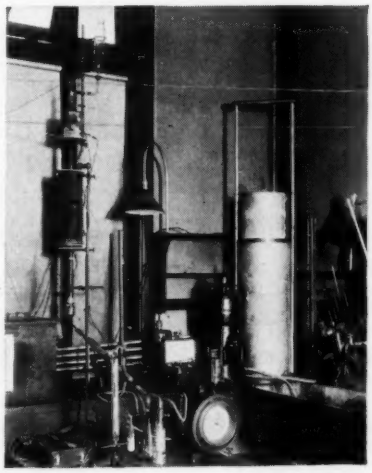
Electrical Process Makes Carbon Black from Distillates

Government Engineer Developes Industrial Apparatus

By Clarence L. Linz
Staff Representative

THE manufacture of carbon black, an important commodity in the printing, automobile tire and many other industries, at any desirable point from light-oil distillates, by an electrical process, has been made possible through experimental work conducted at the Pittsburgh laboratories of the Bureau of Mines by J. J. Jakosky, formerly assistant engineer at that point.

The development of this new base for carbon black opens up important possibilities in that industry. Existing and proposed legislation against the present method of producing carbon black from natural gas and the continually increasing demand for the gas for other purposes, indicate that the supply of carbon black may gradually decrease and that new methods of production must be developed. A process for making the product directly from oils, it was found, seems to possess advantages over the present methods of making the black by incomplete combustion of natural gas. The industry now is prevented from expanding by the imposition of state restrictions, although use of the product is increasing and the price is rising. At present, Louisiana is the center of carbon-black production in the United States, and it has to be shipped comparatively long distances to the chief markets, at freight rates that are high because of the bulkiness of the black.

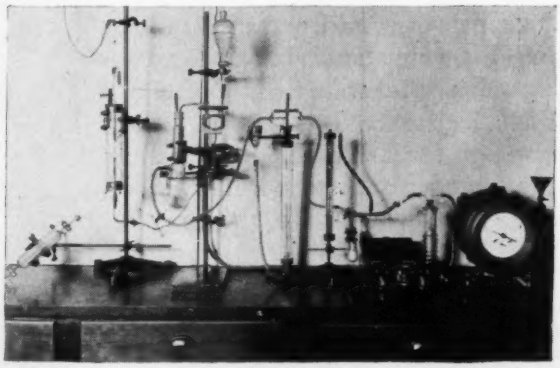


Apparatus for cracking in the vapor place with a corona discharge

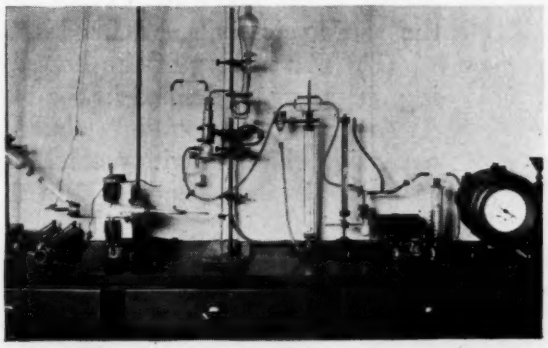
The manufacture of carbon black, as is generally known, is accomplished by allowing the yellow flame of natural gas burning with an insufficient supply of air to inpringe against a cool metal surface. The black collects on this surface, whence it is removed by mechanical scrapers into hoppers that have screw conveyors to carry it to the packing house, where it is bolted, sacked, and prepared for shipment.

Electrical Fixation Studied

Before undertaking investigations of the possible use of oil as a basis for carbon black, a study was made of the possibilities of electrical fixation of black from natural gas. The equipment devised is shown in Figures I and II. Figures III



Apparatus for the manufacture of carbon black from natural gas by the high voltage arc



Apparatus for manufacture of carbon black from natural gas by the magnetic-spread arc method

The Patent Situation
and
The Dubbs Cracking Process

It is a matter of pride with us that the general principles which constitute the Dubbs Cracking Process today, are the same as in the beginning of its career The elements are:

(*a*) A pipe still
(*b*) An enlarged expansion chamber
(*c*) A dephlegmator
(*d*) A condenser
(*e*) Operation under self-generated pressure, as defined in patent No. 1123502

Under later patents, we claim the exclusive rights for the Dubbs Process:

(1) The return of the reflux condensate to the system for further treatment, as defined in the claims of issued patent No. 1392629

(2) The return of the reflux condensate to the system for further treatment by forced (mechanical) means (pump), as defined in the claims of issued patent No. 1525281

(3) A controlled dephlegmation of the vapors, as defined in the claims of issued patent No. 1484445

(4) The "overhead feed" of the charging stock, as defined in the claims of issued patent No. 1488325

(5) Operation at differential pressures in the system, as defined in the claims of issued patent No. 1534927

(6) The passage of independently heated streams of charging oil and reflux condensate to a common vaporizing zone as defined in claims of issued patent No. 1537593

(7) The "split feed" of the charging stock, part overhead, part direct to the heating elements, as defined in the claims of issued patent No. 1522425

(8) The passing of the heated oil, through a series of heated vaporizing chambers, as defined in the claims of issued patent No. 1440772

(9) Passing the oil in a closed cycle through the heated element and expansion chamber with recracking of reflux condensate and withdrawal of heavy residuum, as defined in the claims of issued patents No. 1534927 and No. 1281884

(10) Bubbling the vapors through oil pools in the dephlegmator with heat interchange with the charging stock, as defined in claims of issued patents No. 1488325, No. 1525281 and No. 1546634

(11) A coke-like carbonaceous fuel produced by cracking, as defined in the claims of issued patent No. 1517830

There are numerous other patented features embodied in the Process and covering the apparatus We have more than 700 pending applications for patents

* * *

You never find an unsuccessful device or process infringed The greater its success, the greater the temptation

"Pirating is an old art—it started on the high seas
Infringement is its wicked partner and successor on land"

There are two types of infringers

(*a*) Those who claim they didn't know
(*b*) Those who do know, but deliberately appropriate the rights of others

By means of this announcement, we want to eliminate all those who belong to class "a"—Everyone shall know

We shall then by orderly legal proceedings endeavor to establish our rights and protect our licensees against infringement of our patents

Universal Oil Products Company
Owners of the Dubbs Process
310 South Michigan Ave
Chicago Illinois

and IV show the equipment developed for the manufacture of carbon black from oils.

The experiments were largely confined to treating kerosene or gas oil, as these are easy to work with and the results may be watched a little more closely than when heavier oils are used. However, gasoline, naphtha, benzol, creosote, alcohol, pine-tar oil, fuel oil and transformer oil also were used, and a satisfactory grade of black was made from each of these oils.

Oxygen compounds, Mr. Jakosky found, seem to break down more easily and requires less expenditure of power than the straight-run paraffin hydrocarbons; and it seems probable that some of the cheap creosote distillates or light hardwood oils may be used satisfactorily in regions where they are produced and where cheap petroleum distillates are not available, but there are some disadvantages in their use and the resulting product is not of as high a grade.

Suitable Oils

The lower the viscosity of the oil treated the easier is the separation of the black from the oil after treatment. When heavy viscous oils are used there is considerable difficulty in removing the black. The data compiled by Mr. Jakosky indicates that a suitable oil will be unrefined kerosene distillate, or an unrefined light cracked distillate such as that produced by cracking gas oil in Burton stills. This distillate, because of its high vapor pressure, is usually unsuitable for further cracking in the ordinary type of stills, and largely because of its high unsaturation is not considered highly suitable for refining or blending and marketing.

The method followed by Mr. Jakosky was that of breaking down the oil by use of an electric arc. The oil breaks down into elemental carbon, hydrogen, some methane and, depending on the type of oil treated, arc temperature and other conditions, into considerable quantities of light unsaturated gases. The apparatus shown in Figure V was developed and patented by Mr. Jakosky for the semi-industrial production of carbon black by continuous high voltage.

How Apparatus Works

In this apparatus the oil would be placed in a suitable storage tank and then passed through a circulating pump to a header at the top of the counter-current gas scrubbers. From the header the oil would flow down through the scrubbers into the treating chamber. After passing through the arc or treating chamber, the treated oil would flow to a settling tank. In the settling tank the clear oil would gradually rise to the top and pass out through an overflow either back to the original storage tank or to stills for redistillation. The carbon from the settling tank could be drawn out near the bottom in the form of a sludge and treated. The gas produced during the decomposition of the oil in the arc chamber would be passed through the scrubber, countercurrent to the incoming oil, and out of the gas outlet at the top of the header. This gas coming from the arc chamber contains a large amount of carbon in suspension. In order to aid the scrubbing process, it may be beneficial to have the entire system under pressure, in which case the pressure valve at the top of the header could be set for any value.

The carbon black suspended in the oil may be removed by a number of well-known filtering or drying methods.

Investigation of the unsaturated gases produced during the decomposition of the oil indicated that they may be profitably utilized for the manufacture of alcohols. In the arc the heavier, more complex hydro-carbons break down almost completely into carbon, hydrogen, and the gaseous members of the saturated and unsaturated series. Little if any light, condensable hydro-carbons, such as gasoline, are formed during the process; and tests of an oil that had passed through the apparatus 15 times showed practically no change in specific gravity, unsaturation (as determined by the amount absorbed in concentrated sulphuric acid), initial boiling point, end point, and average boiling point.

The unsaturated hydro-carbons formed during the process are non-condensable at ordinary pressures, it was found; they probably consist almost wholly of ethylene, with some prophylene and other light homologues of the olefin series. In the electrical production of carbon black from oils, also, permanent gases are formed. The amount of these per pound of carbon black varies with the type of oil being treated and the electrical conditions within the treaters. Under the best conditions —that is, with minimum power input for each pound of black produced—the production of gas will be about 55 cubic feet per pound of black recovered. This gas is suitable for domestic fuel, and it has essentially 10 per cent methane (CH_4), 50 per cent hydrogen (H_2), 35 per cent unsaturates, and 5 per cent CO, CO_2, O_2, and H_2. A plant producing 2000 pounds of black a day will produce 110,000 cubic feet of gas a day, or 33,000,000 cubic feet in a year of 300 operating days, the sale of which would reduce the net cost of producing the carbon black. If alcohol recovery or other use is made of the unsaturates in the gas, the hydrogen and other constituents remaining after their removal may be used as fuel for reconcentrating the absorption sulphuric acid and for concentrating and rectifying the alcohol.

Good Industrial Possibilities

The data available from Mr. Jakosky's laboratory investigations indicate that the electrical process has good industrial possibilities. It is impossible, of course, to estimate accurately from laboratory data the cost of producing carbon black electrically on a large scale.

For manufacturing carbon black from oils by the process described, the main essentials are cheap electric power and cheap light oil distillates. As the process is simple, complicated special equipment is not necessary. Aside from the arc treaters themselves, apparatus for handling the oil and for the filtering, drying and air separation of the black is of standard design. At most of the carbon black works, high voltage current such as is available at power plants could be used directly, and transformer stations would not be required, although suitable current-limiting reactances would be necessary.

The electrical process seems suitable for part-time or intermittent operation, and could, therefore, utilize the off-peak power available to many hydro-electric and turbine power plants. As this off-peak power can be purchased at lower rates in most cities, carbon black could be made near the industries using it, and a considerable saving in freight rates alone could be effected.

A plant manufacturing carbon black by this arc process will probably be composed of a series of separate units. By reason of the low cost per unit and the suitability of the process for intermittent operation, a plant composed of a multiple of units will be flexible enough to operate on a five-minute demand basis and to follow the available off-peak power curve fairly close. Such a plant will be able to obtain the lowest existing rates for power. An abundance of cheap off-peak power may be obtained in practically all parts of the United States at rates ranging from about one mill to five mills per kilowatt hour.

The cost of producing carbon black by this process will vary with the cost of electric power and the cost of the oil.

Gray Process Installations

Recent orders received by the Gray Process Corporation of Newark, N. J., have come from the Compagnie Belge du Gaz Catalytique, Brussells, Belgium; the Argentine Government, La Plata, Argentina; McColl Brothers, Ltd., Toronto, Canada, and the Lubrite Refining Company, East St. Louis, Ill.

Quimby Pump Bulletin

William E. Quimby, 209 Parkhurst St., Newark, New Jersey, pump manufacturers, announce a four-page bulletin describing their Quimby Screw Pump.

This pamphlet shows three sectional views of the pump, one suitable for handling water, calcium brine, etc.; one for handling oil containing lubricating qualities; and one for handling semi-fluids, such as tar.

Copies of the pamphlet will be sent to any one interested, upon request to the company.

Wichita Falls, Texas.—The Dale Oil and Refining Company has been organized with a capital stock of $150,000 with headquarters at Wichita Falls following the purchase of the refinery and pipe lines of the Griswold Oil Corporation by J. E. Dale and associates at a trustee's sale in August. The skimming plant, which has a daily capacity of 2500 barrels, is located at Electra, and has resumed operations under the new ownership.

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As rapidly as our growing volume of business warrants, we will add new warehouse stocks at other distributing centers. We are also prepared to make prompt shipments from our works at Niagara Falls in any quantity up to carload lots. Mathieson Aqua Ammonia is supplied in standard 110 gal. drums and 8,000 gal. tank cars.

We cordially invite oil refiners to visit us at the International Petroleum Exposition, Tulsa, Oklahoma, October 1 to 10, 1925. Our booth will be No. 66 in the West Virginia Building.

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Panhandle Crude Shows Excellent Gasoline Content

By George W. Reid, C. E.

THE following discussion of crude petroleum analysis, comparing certain methods and practices of inspection, is taken from recent experiments with petroleum from the fields of the Texas Panhandle. As this territory is fast becoming a factor of consequence in the production of oil, it is possible that the physical characteristics of the crude produced will be of general interest to the industry.

Quantitative Distillation

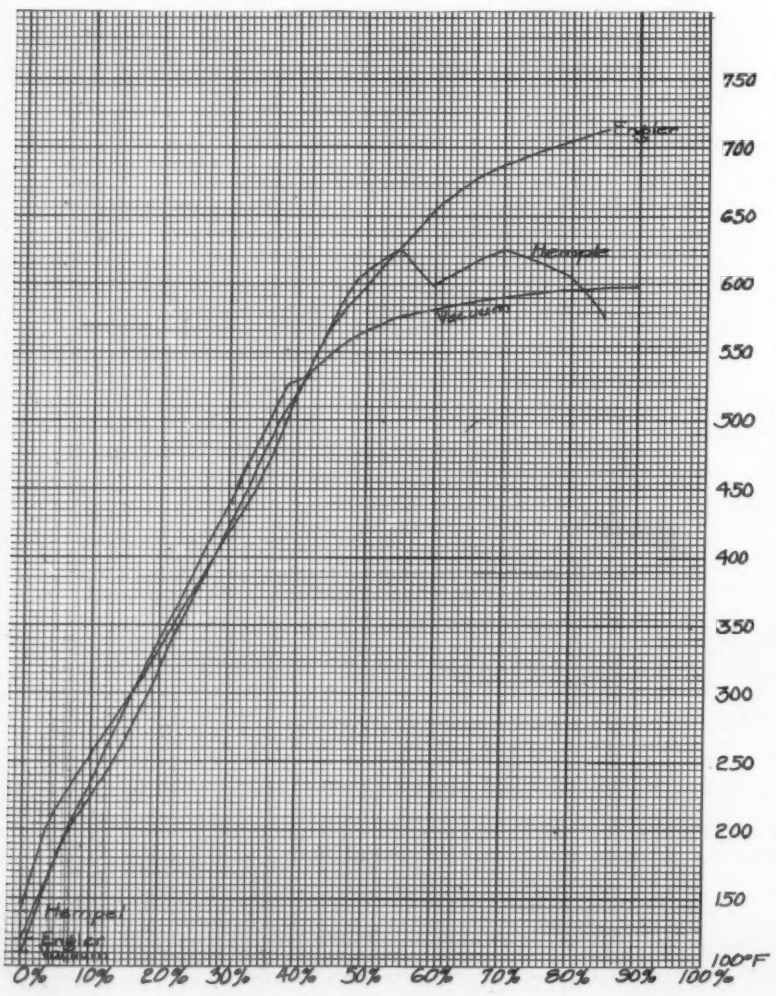
The most valuable method of analysis of crude petroleum, and the method of examination and inspection prevalent with refiners, is that of quantitative distillation. Analytical or quantitative distillation, commonly referred to as fractional gravity distillation, of petroleum is necessary to determine range of boiling points, to separate the oil into its fractions, and to acquire information as to the "content" in percentage of the so called "cuts". This practice is the most accurate means of determining the valuation of any particular oil.

The procedure, as practiced in most refinery laboratories is not a highly tedious operation. The degree of minuteness of measurement and the accuracy of the data required, differ, of course, with various organizations. Often only comparative figures of the simplest kind are required. However, due to difference in characteristics of crude oil, both physical and chemical, and due to the many different kinds of information and requirements occuring in the industry, no one arbitrary method of distillation can be universally applicable.

Generally a fractionating column of the Hempel type is employed, the column being packed with either aluminum beads, glass beads of varying sizes and shapes, or the familiar "length of iron 'jack' chain of about No. 18 size, sufficient in length to pack under its own weight into a column one inch in diameter and six and one half inches long"—as recommended by the Bureau of Mines.

Certain organizations still cling to the Engler type of still; vaporizing only through the kerosene range, but separating the fractions according to predetermined temperatures. Due to lack of close fractionation any inspection of the collected distillates is more or less useless. This is merely a method for simple distillation and approximate work.

The method of analysis employed where accurate determination of quality and quantity is desired, is that which includes in the apparatus the well packed Hempel column. This column gives equivalent results to efficient fractionation devices, such as recycle and bubble type towers; as are extensively applied to refinery operations.



Vacuum Distillation

Distillation of most Mid-Continent and western crude oils may be generally safely carried to a temperature of 527 to 572 degrees F. before cracking is encountered. Evidence of cracking is an increased flow of distillate, a very slow or retarded advance of thermometer reading, a stationary reading, and often a receding thermometer. Often a thick fog of uncondensed vapor appears with the distillate, a rattling noise comes from the flash or retort, and the fumes of distillation become very noxious. The evaporation of the residue boiling above the cracking temperature and the collection of various cuts of different ranges of volatility may be accomplished with crackling eliminated by reducing in a current of steam, or under vacuum.

Distillation in the presence of steam is, as a rule, resorted to in commercial refining primarily because it is cheaper, easier to control on a large scale and is regarded generally as being just as effective in preventing cracking as is the application of vacuum. Steam distillation is also frequently employed in the laboratory. Boiling, a physical change, occurs only when the vapor pressure of the oil is in slight excess to the pressure of

TABLE 1

Vacuum Distillation—Panhandle Texas-Crude Petroleum
Engler—direct fire to 525 degrees F.—38.3% recovered.
Vacuum—28 inches—from 38.3% to 90% recovered.
Charge—4000 CC. Gravity crude—35.8 degrees A.P.I.
Initial Boiling Point—112 degrees F.

10 % over at—240 F.	1st cut—370 E. P.		
17.5% " " —310 F.	Gasoline—64.5 A.P.I. gravity		17.5%
20 % " " —340 F.	2nd cut—455 E. P.		
26.6% " " —410 F.	Naphtha—51.0 degrees A.P.I. gravity		9.1%
30 % " " —440 F.	3rd cut—595 E. P.		
38.3% " " —525 F.	Kerosene—42.7 A.P.I. gravity		11.7%
Vacuum—28 inches.			
40 % over at—525 F.			
50 % " " —565 F.	4th cut—		
60 % " " —580 F.	Gas oil—35.5 A.P.I. gravity		21.7%
70 % " " —590 F.	Wax distillate.		
80 % " " —594 F.	cold test—80 degrees F.		
90 % " " —597 F.	5th cut—32.0 A.P.I. gravity		30.0%
8 % Residuum—10.9 A.P.I. gravity			8.0%
Loss			2.0%
Total Navy gasoline—one cut—26.6%.....			100.0%

TABLE 2

Engler distillation—500 cc. charge
Panhandle, Texas, crude oil. Direct fire—no steam, no vacuum. Engler Flask.
Crude gravity—35.8 degrees A.P.I.
Initial Boiling Point—130 degrees F.

5%—220 F.			
10%—252 F.	66.8	Gasoline—374 E. P.	
15%—292 F.			
16%—300 F.	59.0	1st cut 63.2 gravity.....	16.0%
20%—325 F.		IBP—155—E. P.—455	
28%—400 F.	51.0	2nd cut—51.0 gravity	12.0%
30%—418 F.			
35%—460 F.		Kerosene—IBP—345	
40%—518 F.			
43%—535 F.	42.1	3rd cut, 42.1 gravity	15.0%
45%—553 F.			
50%—600 F.	38.0		
60%—656 F.	35.5		
70%—687 F.	34.0	(cracking unit stock)	
80%—705 F.	33.3	Gas Oil	
85%—715 F.	33.0	4th cut—34.4 gravity	42%
13%—Residuum—no coke—12.2 gravity			13%
Loss			2%
Total Navy gasoline—one cut—28%.....			100%

TABLE 3.

1000 cc. charge—Direct fire distillation—Panhandle crude.
Hempel distillation to 535 degrees F.—no beads to 85% vaporization.
No steam—no vacuum. Gravity crude—35.8 degrees A.P.I.
Hempel I.B.P.—117 degrees F.

5%—185 F.	Gravity cuts.		
10%—225 F.	71.0		
15%—267 F.		Gasoline—372 E. P.	
19%—310 F.	58.5	1st cut—64.2 A.P.I. gravity...	19.0%
20%—317 F.			
25%—372 F.		Naphtha—447 E.P.	
29%—410 F.	49.5	2nd cut—49.5 A.P.I. gravity..	10.0%
30%—417 F.			
35%—480 F.			
40%—518 F.		Kerosene—IBP—404 degrees F.	
43%—535 F.	42.3	3rd cut—42.3 A.P.I. gravity..	14.0%
No beads—			
45%—570 F.			
50%—610 F.	37.5	(cracking)	
55%—620 F.	37.5		
60%—595 F.	37.2		
70%—625 F.	38.4	Gas Oil cut.	
80%—605 F.	37.9	(cracking unit stock).	
85%—575 F.	39.3	382 4th cut. 38.2 A.P.I. grav.	42.0%
13%—Residuum—13.8 degrees A.P.I. gravity....			2.0%
Loss.....			2.0%
Total Navy gasoline—one cut, 29%.....			100.0%

the atmosphere above it. The boiling point of a liquid may be lowered either by balancing a portion of the atmospheric

(Continued on page 63)

GARLOCK

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The New Era

PETROLEUM production and refining have passed through the formative stages and are today the nucleus of a great and stable industry.

With this stability new methods and practices have come into being. Whereas more or less make-shift equipment and procedure were once too often the order of the day, the industry is coming to accept a new watchword —Efficiency.

Braun engineers have anticipated these changes, and where possible, have pointed the way to improved processes and equipment. Now that genuine stabilization is in sight they are prepared.

If you are interested in securing the benefits of the combined experience and research of a group of technical experts, let the Braun engineers analyze your refinery problems.

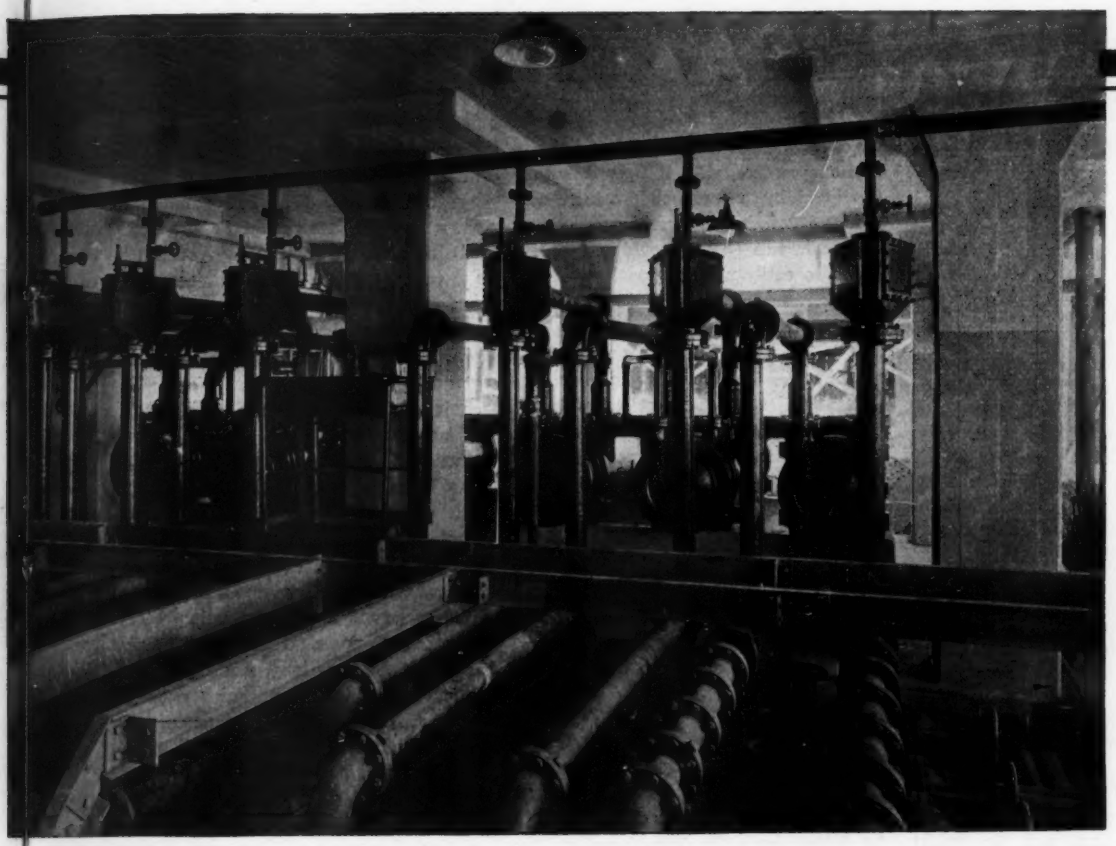
Bulletin 112-A contains a thorough and informative discussion of Braun fluid heaters, coolers, and heat exchangers. You should have a copy.

C.F. Braun

Manufacturing Mechan

Main Office and Factory — Al

Mid-Continent District Office



Above: A battery of Braun coolers, supplementing box condensers. In this installation a high degree of efficiency is obtained. Circulating water at a temperature of 66 degrees reduces gasoline to 70 degrees.

Right: Three vertical condensers handling 2500 bbls. per 24 hours. Temperature of gasoline is reduced to within 5 degrees of entering water.

aun & Co.
Mechanical Engineers
ctory — Alhambra, California
ict Office — Tulsa, Oklahoma

How Much Heat Can a Man Stand?

MANY refiners long have realized that in the varying elements in the atmospheric conditions under which their refinery workers labored and in the extremes of the temperatures and humidities to which these men are subjected lies the secret of efficient or inefficient work and all the shades of difference between the two.

Heretofore, however, intelligent adaptation of working conditions to fit atmospheric conditions, or efforts to change the atmospheric conditions themselves within the confines of the plants have been for most refiners merely a lot of guesswork because of the lack of accurate and scientific data along which to plan and gauge such work of improving atmospheric elements.

In a great many refineries, therefore, there will be much interest in the information that government authorities have conducted some exhaustive tests and systematic examinations into the matter of the effects of heat, humidity and similar elemental factors have upon human beings. Private concerns also have been active in helping with research work which has been done along this line.

The results of some of the tests of the Bureau of Mines and the public health service were only recently made available.

Laboratory Experiments

As it was believed impractical to make tests in the industries because of the handicaps there to accurate and scientific tests, elaborate experiments were conducted in the laboratory and the results as far as possible applied to actual industrial conditions. It is stated that the effects of moderately high temperatures and humidities are more difficult to measure perhaps than the extreme conditions, but that they may be predisposing causes of fatigue, discomfort and disease.

Human subjects were used for all tests. The survey included investigations in physiological effects of various temperatures and humidities on human beings at rest in still air; physiological reactions to different temperatures and humidities; with various air velocities, of subjects at rest; physiological reactions to different temperatures and humidities with various air velocities, of subjects performing either physical or mental labor; and changes in these reactions while the subjects were at work in still air.

Some of the conditions to which the subjects were subjected were quite extreme.

An outstanding fact which seems to have been developed is that a worker providing he is stripped to the waist and resting in still air, can remain normal at an extreme limit of 90 degrees Fahrenheit temperature, with 100 per cent relative humidity, and can endure these conditions indefinitely. These conditions, of course, it was shown, could not be endured so easily nor even so long in any situation, when the subjects were performing labor.

It is indicated, from the result of the experiments, that a worker in an oil refinery, subjected to great extremes in temperature, can compensate for great varieties of external temperature and humidity and that there is no marked increase in respiration in spite of these extremes. However, it was found that the subjects sometimes believed themselves to be breathing much faster in high temperatures than really was the case, in one case a subject counting 44 respirations per minute, when really he was breathing at the rate of but 12.

Fats vs. Leans

Interesting facts are indicated with reference to the ability of workers of varying size to withstand atmospheric conditions. The conclusions which might be drawn from the tests, based on the actual results, would be that the heavier and stouter men lost more weight subjected to the extremes than the lighter and thinner men. Notwithstanding this, in the experiments the lighter men as a rule could not endure the temperature conditions so long and complained more of the exhaustion which followed. The scientists, however, refuse to be responsible for the statement that all stout men can stand heat better than thinner ones.

Apparently the supplying of ice water in copious quantity to refinery workers subjected to great heat is not in violation of the best interests of the employes. It has long been said that the drinking of ice water after exertion in heat was injurious. It was found in this survey that whenever the subject drank ice water, he immediately gained in weight. In any case he usually regained the entire weight lost within 24 hours, indicating no permanent necessary loss even under trying circumstances. It frequently has been stated that workers exposed to high temperatures develop severe cramps after drinking ice water. A few of the subjects volunteered to drink ice water after an hour's exposure to high temperature and two of them, in one experiment, drank a quart in less than fifteen minutes without ill effect. Cramps did not develop in any of the subjects at any time.

Conjunctivitis, that disease of the eyes, is known to be present among many refinery workers. It was demonstrated in these experiments that this and similar eye trouble caused by inflammation of tissues of the eye, could be practically eliminated or at least greatly reduced by the wearing of sweat-bands by the workers. On one day when the eyes of the subjects were normal, a small quantity of sweat, which had been collected in an experiment, was dropped in the eye. The conjunctive almost immediately became inflamed and the eye felt sore. The perspiration collected from the face seemed less irritable than that collected from either the chest or the arms. Sweat-bands then were applied to the forehead during the experiments, these preventing the sweat from falling into the eyes, and also prevented the inflammation. This was taken to prove sufficiently that sweat is the chief factor in producing the conjunctivitis, which accompanies exposure to heat. A refinery superintendent, on the strength of this, might find it profitable to provide every worker subjected to heat with a sweat-band and no doubt the slight expense would be easily made up from increased efficiency due to eliminating conjunctivitis from the workers.

Results Summarized

It is stated that the accuracy of the results obtained in such studies depend largely upon the equipment of the experiment chamber, as well as the precision of the instruments available for measuring physiological reactions.

In the work considered here, two fully equipped chambers, insulated by cork board, were designed to maintain air conditions at a desired temperature and humidity. The temperature, humidity and air motion of each room is maintained independently of the other.

To summarize the final report of the survey:

There is an inability of the body at rest and in still air to compensate for saturated atmospheric conditions exceeding 90 degrees F.

The physiological effects resulting from exposure to high temperatures and humidities depend upon both the wet and dry bulb temperature readings.

The exhaustion and weakness following the subjection of human beings to a very high temperature and humidity for a short period is not so severe as a subjection to a moderately high temperature and humidity for a longer time.

The pulse rate, rather than the rise in body temperature, apparently determined the extent of discomfort experienced by the subject. Subjects became very uncomfortable and complained of unbear-

MOTOR MUSIC
ON all eight . . . a perfect beat . . . a rythmic whirr . . . a steady roar . . . the pilot's ear tuned to motor music is satisfied. He skims the ground like a swallow . . . takes wing . . . and rises to meet the sun.
This is the day of efficient transportation in which "Natural Gasoline plays its part.
This new era demands a super motor and a super fuel of high volatility. Modern motor fuel contains its percentage of "Natural Gasoline"
CHESTNUT & SMITH CORPORATION
TULSA, OKLA.

able and distressing symptoms when the pulse exceeded 160 per minute. The highest pulse rate recorded was 184 per minute.

The curve of rectal temperature showed a close parallelism with the curve of the temperature of the test chamber at any constant humidity.

Subjection to high temperatures and humidities produced no marked changes in respiratory rate.

Loss of weight varies with the individual, the loss increasing with the length of exposure to high temperatures and the severity of the test.

The hemoglobin content of the blood increased proportionately to the loss in weight.

An estimation of the changes in sugar content of the blood proved to be negligible.

A relative increase in the blood count was found, but not an absolute one.

The rate of sweating increased with the atmospheric temperature at about 91 degrees F. The loss of substances from the body through the sweat did not vary in proportion to one another.

The sweat was the chief factor in producing irritation and inflammation of the eyes.

Ice water, when swallowed in large quantities, did not cause cramps under the conditions of the experiments.

The refinery superintendent, desiring to know just how his men feel when subjected to steadily increasing temperature and humidity up to extreme conditions probably can learn from this brief description of the actions of the subjects in these experiments:

Effect on Men

The men who frequently at the start were in a happy mood and of a joking disposition, soon became restless and irritable. They complained of headache and palpitation of the heart. The headache soon became throbbing in nature and the palpitation distressing. Great thirst was experienced. The eyes became inflamed and sore. A feeling as of a weight on the chest was noted. The voice suffered somewhat, in that it became an effort to speak. Dizziness and confusion followed. After leaving the chamber it was necessary to sit down and rest for five or ten minutes before taking a shower. Weakness and a "dragged out" feeling continued for some time, depending upon the severity of the test. A metallic taste was a noticeable feature, and persisted for one to two hours following high temperatures.

It was at first believed that the presence of the subjects in the test chamber might reduce the oxygen and increase the carbon dioxide content of the atmosphere so that the symptoms complained of could be attributed to a low percentage of oxygen and a high percentage of carbon dioxide. This, however, was found by numerous air analysis not to follow. The samples of the air were taken by the standard vacuum tube method. Analysis proved the maximum amount of carbon dioxide found, even at the end of the experiment, was never greater than 0.17 per cent, and that the oxygen never fell below 20.72 per cent, showing only very small change from normal.

Men Weighed

At the end of a two-hour preliminary period the subjects were accurately weighed before entering the test chamber. During the high temperature experiments the subjects were stripped to the waist, thus approximating the condition of men in the industries. The subjects remained in the test chamber for a period of three hours whenever possible. In some experiments, where the temperatures were high and accompanied by high humidity, the subjects were not able to remain therein for the entire period as collapse and even death might result before the lapse of three hours. In these tests the subjects frequently remained until the conditions became unbearable. Frequently in these extreme tests the pulse rate exceeded 160 beats per minute and the body temperature reached 104 degrees F. On leaving the chamber the subjects were again weighed and a record kept of the fall in body temperature and pulse rate.

Of the physiological disturbances that occur when subjects are exposed to abnomal atmospheric conditions, the results of the experiments emphasize the importance of the circulatory system. Were this work confined to a single physiological measure of discomfort due to high temperatures—in the light of present experimental evidence—the pulse rate would be selected as probably the best index. Investigators, however, realize that the body temperature alone is not the cause of the discomfort of men in hot industries, and their conclusions as a whole are that the discomforts undoubtedly depend to some extent on other causes than the rise in body temperature.

The rise in blood pressure no doubt contributes to the discomfort. Subjects described the sensation felt on reaching the unbearable condition as follows:

First, a slight palpitation of the heart occurs, which increases in severity until a feeling of floating in the air is experienced. This is accompanied by dizziness and frequently with a numbness or soreness of the face, and with nausea. The body temperature apparently is not an influencing factor in these cases.

On the whole it appears that refinery general managers and superintendents might be justified either in carrying out supplementary research work of their own along the lines suggested by these experiments or in adopting some methods for relief as far as possible from certain conditions suggested above in connection with effects on workers of abnormal conditions of temperature and humidity—this both in the interest of welfare of the employes and more efficient work produced.

Tagliabue Issues Indexed Instrument Catalogue

The new Tagliabue catalogue has been planned and designed for the utmost convenience of the users of thermometers, pressure gauges and other recording instruments. Up to the time of its appearance, no similar catalogue —not even the previous editions of this one—has enabled the users of instruments to dispense with the services of the instrument salesman, except in the case of certain self-contained instruments, and then only when there was not much choice between various types and ranges.

Full information is supplied in the new catalogue, and this information is repeated again and again to obviate any figuring on the purchaser's part as well as to eliminate the turning back and forth of pages. Inasmuch as recording instruments are not only the most widely used instruments covered in this catalogue, but also those which up to now have caused the greatest exasperation on the part of users, it is interesting to summarize the various features involved in selecting instruments.

1. What type? The answer depends upon the range, the bulb material and the connecting tube length.

2. What range? This depends upon the application, the degree of accuracy required, and other factors.

3. What bulb? This depends upon the application, the shape of the apparatus, the substance coming in contact with the bulb, etc.

4. What connection? This depends upon the type of apparatus, and other factors.

5. What duration of chart? This depends upon the application.

6. What finish? This is, naturally, optional with the user.

Now, observe that only in the case of this last item is the reader required to turn to another page. With this catalogue it is at last possible for the prospective user to find the instrument he is looking for and to order it by catalogue number, adding only the length of connecting tube and the chart number.

All this applies to the dial indicating thermometers, which are even easier to order since the item of chart duration is eliminated.

The publishing of this catalogue is in line with the recommendations of Herbert Hoover, Secretary of Commerce, to reduce the cost of distributing products between purchaser and consumer. It saves time and frees the purchaser from the necessity of consulting instrument salesmen. Order for any instrument may be sent in a ten-letter telegram, without the least possibility of getting any instrument except the one you want, equipped as you want.

Cook has pioneered again, this time with a

fresh

READY-TO-MIX ALUMINUM TANK PAINT

Now, in this *new* and *unique* package, you may buy Aluminum Tank Paint that is sure to be *fresh.* Because it *is* fresh, it has greater "leafing power", it wears better, and it reflects light and heat most effectively.

Science has proved that Aluminum Paint, to be most effective, must be applied when freshly mixed. It has remained for the Cook Paint and Varnish Company, pioneers in the manufacture of paints for the oil industry, to devise a paint package which assures *easy and foolproof mixing.*

When you use Cook's Aluminum Tank Paint, you get Liquid and Powder in exactly the right proportions, ready to mix. It is bright, shiny, *new* paint—with a covering capacity of 750 square feet to the gallon. The greater leafing power of the fresh Aluminum "seals in" the paint, giving maximum wear and maximum heat reflection. One coat will do the work. It may be applied with either brush or spray.

As an undercoat, use Cook's Rust Inhibitive Primer. It prepares the surface so that less Aluminum Paint is required; and firmly anchors paint to metal.

For dado work on tanks, use Cook's Steel-Kote, the toughest paint film known. It spreads farthest, covers better, wears longer. Preserves steel and prevents rust.

Powder in the Small Bucket (A) Liquid in the Large Bucket (B) Together in a 5-Gallon Package

The large bucket "B" contains the Liquid and a separate bucket "A" which contains the Aluminum Powder. Remove the lid of the large bucket and take out the smaller Bucket containing Powder. Cut out the soft tin top of Bucket "A" and dump the Powder into the Liquid. Stir well with a wide, flat paddle that is long enough to reach the bottom of the large bucket.

Mix It on the Job as You Use It—

This *fresh* mixture gives a bright, shiny paint of superior quality, containing exactly the proper proportions of Powder and Liquid. Science has taught us that Aluminum Paint must be freshly mixed to be most effective. This unique Cook package assures *easy, foolproof mixing.*

Fight Sunshine with Cook's Tank Paint —Save 200 Barrels Yearly, Per Tank!

Government field tests on 55,000-barrel crude oil storage tanks show that Aluminum-painted tanks lose by evaporation 200 barrels less oil in a year's time than black tanks.

Black tanks absorb the heat from the sun's rays, causing excessive evaporation. Aluminum-painted tanks *reflect* the sun's rays, and thus remain cool. It's cheaper to paint a tank than to lose 200 barrels by evaporation!

Cook Paint and Varnish Company

Pioneers in the Manufacture of Specialized Paints for the Oil Industry

Factories: Kansas City and Fort Worth

8 Warehouses for Quick Shipments in the Mid-Continent Field: Omaha, Wichita, Oklahoma City, Tulsa, Dallas, Denver, Fort Worth, Kansas City.

Mail This Coupon Today for Cook's

Special Introductory Offer

Cook Paint and Varnish Company, Oil Industry Service Dept.
1319 Grand Avenue, Kansas City, Mo.

Gentlemen: Please send me full details of your Special Introductory Offer on Cook's Ready-To-Mix Aluminum Tank Paint, in the new 5-gallon package. Also send me information regarding your Rust Inhibitive Primer and Cook's Steel-Kote. I (have) (have not) seen your booklet "Cook's Paints for the Oil Industry". Please send me a copy.

Company
Name.....

Individual
To Address.....

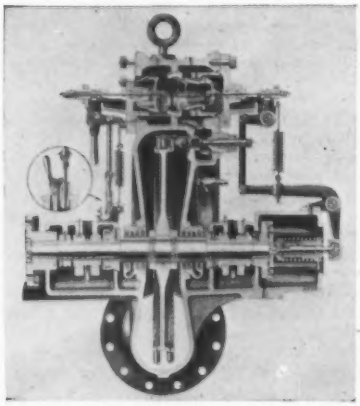
City and State.....

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

Compactness Is Big Feature Of De Laval Turbine

Recent marked increase in steam pressures and temperatures has made necessary the re-design of many steam using appliances among which the De Laval velocity stage turbine holds a foremost place.

The casing of this turbine is intended to be supported on a single pedestal at a point close to its center line. The use of a single support diminishes the liability to distortion troubles, as the turbine can expand freely in all directions without affecting the alignment of the shaft. Two bearings support the shaft, one at either



Axial Section of De Laval Velocity Stage Turbine

side of the housing. A flexible coupling connects the turbine shaft to the shaft of the driven machine.

Upper half of the casing includes the steam inlet nozzle, steam chest, and governor valves, thus shortening the steam passages and reducing radiating surface and also keeping high temperature steam away from the bearings, bearing oil reservoirs and bearing supports.

Water cooling is not required. The governor valve casing, steam chest and the upper half of the turbine casing are cast integral and are made of steel for high pressure and high temperature steam. There are no cross-over steam connections. The only joint in the casing is therefore the horizontal joint at the plane of the center line of the shaft, dividing the lower half or casing proper from the upper half, or cover, and this joint is subjected to steam at exhaust pressure only. The combination of the valve casing with the steam nozzle and steam chest has also made possible a very compact arrangement of the speed governor valve and emergency trip valve.

The turbine has been designed to obtain the maximum of compactness and simplicity, and its speed governing features along with its other superior points make it a very useful piece of equipment. All parts entering into the construction are made to limit gauges to insure absolute interchangeability of parts.

Additional data can be had from the De Laval Steam Turbine Company, Trenton, New Jersey.

New Separator for Removal Of Water From Steam

For the effective removal of water from high pressure steam before it enters the engine or turbine, at all velocities and regardless of the quantity of water present, the Griscom-Russell Company, 90 West Street, New York City, is announcing the New Stratton Separator.

This separator is a redesign of the famous Stratton Separator which is installed in power plants throughout the world. In the new separator, the helical path has been lengthened in order to increase the centrifugal separating action, and this feature, together with the spatter cap on the outlet pipe, greatly increases the separating efficiency.

For further information inquire of the company.

Refinery Equipment Catalog

Equipment manufactured by the P. H. & F. M. Roots Company, Connersville, Indiana, is described in a catalog just issued. This equipment covers low pressure type rotary gas pumps, foul gas exhausters, valves and by-pass connections, high pressure rotary gas pumps, gas boosters, special duty gas pumps, displacement meters, rotary pumps, and other equipment for use about refineries and power plants.

The catalog also includes engineering tables for use in connection with users of Roots equipment.

Copies will be supplied those requesting them from the company.

Low Pressure Portable Acetylene Generator

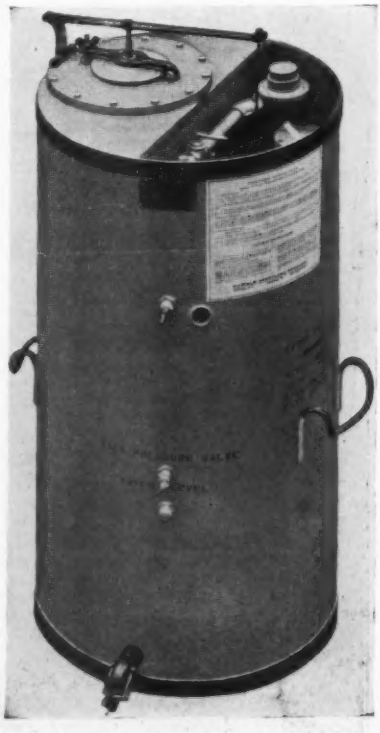
A small generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxweld Acetylene Company, 30 East 42d Street, New York. This supplements a line of larger generators, a great many of which are used to supply pipe lines in shops where much cutting and welding is done.

The new generator, which takes 35 pounds of carbide at one charge, can be transported readily from place to place, thus providing a portable supply of generated acetylene gas. Empty, the generator weighs only 210 pounds.

An entirely new principle of feed control is used which might be called a "heavier-than-water" float. A vertical partition, extending nearly to the bottom into a water seal, divides the generator shell. One side is gas tight and contains the carbide hopper at the top. The upper part of the other side contains gas regulating and protective devices, and an automatic carbide feed control. Generation of the first acetylene causes water to rise on this side of the partititon high enough to all but submerge a pan full of water, hung to a control lever. This pan normally acts as a weight acting counter to a spring, but as the water rises about it, its apparent weight is diminished and the carbide hopper valve is closed by the action of the spring. As acetylene is drawn off, water rises in the gas compartment and correspondingly lowers under the float, relieves some of the buoyancy under the water pan, which, gathering weight with the receding water, depresses the spring and allows a small amount of carbide to drop into the generator, and restore equilibrium conditions.

Because of its low center of gravity, the generator rights itself when tilted at an agle of 30 degrees. It works perfectly at an inclination of upwards of 10 degrees. No adverse effects result if a generator while in operation is knocked over. Nearly all fittings are enclosed in the cylindrical shell and there is little, if anything, projecting which may be injured by a fall.

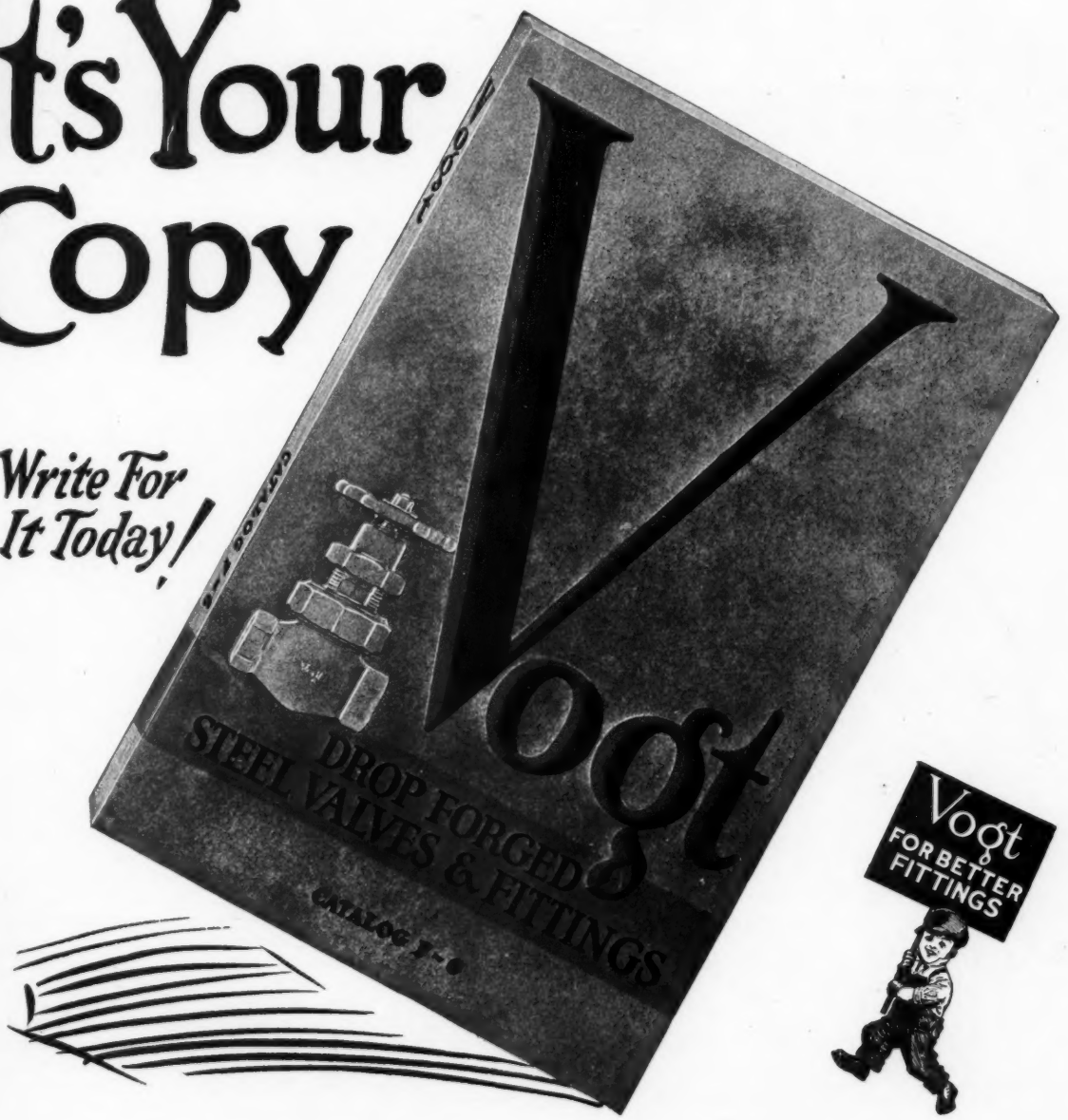
This generator has been submitted to the Underwriters' Laboratories, Inc., and has been listed by them as an acceptable device for installation on insured premises. The company will supply further information.



Portable Acetylene Generator

It's Your Copy

Write For It Today!



A comprehensive book of 187 pages, illustrating the complete line of Vogt Drop Forged Steel Valves and Fittings for high pressures and temperatures of oil, gas, air, ammonia and superheated steam. This catalog also contains an ammonia valve and fitting section for convenience of refineries and other plants using refrigeration.

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KENTUCKY
New York Chicago Philadelphia Dallas

Manufacturers of DROP FORGED STEEL VALVES AND FITTINGS, WATER TUBE AND HORIZONTAL RETURN TUBULAR BOILERS, ICE MAKING AND REFRIGERATING MACHINERY, OIL REFINERY EQUIPMENT.

Water the Crux of The Gasoline Plant

(Continued from page 22)

vented any scale from forming. Suspecting, as we did, that perhaps the nature of the water had changed, we not only caused a complete analysis to be made but, in fact, removed the terminals and operated for several weeks without the equipment and found a gradual reappearance of the hard calcium scale which we had previously experienced.

While we have found in every instance of shut-down a perfectly clean shell in our boilers, we are not yet thoroughly sold on this method of scale prevention because of a new trouble that we were made to face by the elimination of scale. I have reference to corrosion of all surfaces as soon as they come in contact with the air upon opening of the boiler and cleaning out such fine dirt or mud that may have accumulated and which was not expelled through the boiler blow-off.

This is indeed a most serious matter. Some means must be found to eliminate this corrosion. We are endeavoring to do this by the injection into the boiler of sodium silicate which is claimed will coat the hot surfaces within the boiler with a thin film of protection against contact with air. If this process is successful we, at least, will be willing to believe that a sure means of scale prevention in boilers has been found. Meanwhile, we disconnect the boilers several days before they are shut down for inspection and permit a protecting scale to form.

On a Gas Engine

Our experiment with a gas engine has not been successful. However, I wish to point out the fact that this engine was one of the battery of 23 and that there can be no doubt that the generated current leaked by the machine and was spent upon some of the others in the battery. Experiments are being made by the American licensees of the patents with a gas engine in an isolated station, and I cannot see why satisfactory results will not be found for the conditions are certainly similar to that in a boiler and good results in the one case should be a criterion for all classes of equipment of this kind, including even closed condensing units.

The crux of the problem will be the definite attainment of knowledge with respect to the current necessary for the protection of the particular piece of equipment, the prevention of corrosion and the practical perfection of insulating from other metal equipment the units that it is desired to protect.

The initial cost is high but is, undoubtedly, necessary on account of the expense of experiment that had to be performed and the scarcity of sales. I, for one, am hoping that if the thermodynamic cell proves its utility, the cost thereof may be reduced to such an exten that we can unhesitatingly recommend them to our several concerns. A close examination of the equipment reveals little, if any possibility of deterioration of the cell and, inasmuch as there is no expense involved in upkeep, the application with respect to our industry in the various ways that it can be used, can be made to pay dividends by the saving of shutdown hours and the protection of our engines and boilers from extreme abuse.

I do not want to be put in a position of holding the brief for this particular kind of anti-scale, but on the other hand, I can picture no greater pleasure in Heaven than that of operating a gasoline plant or a number of plants without the grief incident to water, and without the necessity of eternally analysing the water with respect to the increasing or decreasing amount, and the nature of the mineral solids, etc., therein, and the necessity of regulating the amount and kind of reacting agents to bring about, at best, only temporary relief. In the one case (I am assuming, of course, the certain proof of the success of this anti-scale) 100 per cent functioning is affected without the personal element; whereas, in the second case, we are depending for results upon the diligence and understanding, and the co-operation of water analysis, plant operation, and the adaptability of the chemicals.

Water Vital

On the one hand we have a high first cost without upkeep; on the other, a small initial investment and a con-

we have established, at New Orleans, extensive storage facilities, where oils may be stored in bulk or in cars, under the usual N. A. Oil Terminal Warehouse conditions.

These facilities, combined with our car-leasing service, our oil terminals at Chicago and Tulsa, and our car repair shops at Chicago, Coffeyville and Tulsa, constitute a well-rounded service to shippers of which we invite you to take advantage.

North American Car Co.

327 S. LaSalle Street Chicago

Petroleum Bldg., Tulsa

A COMPLETE SERVICE IN

"John Crane"

FLEXIBLE METALLIC PACKING

STYLE 110

Gets the Big "O. K." on Centrifugal Gasoline Pumps
Has to run cool— it does
Without friction— it does
Without wearing rod— it does
Has to give long service— it does
Have ample expansion— it does
Be easy to apply— it is
And require only infrequent adjustment— it does

Hundreds of sets now in use and giving perfect satisfaction. If you realize what this problem has been in the past, you can appreciate the perfect present-day service obtained through JOHN CRANE Style 110.

This packing was developed especially for this service. For JOHN CRANE results, buy only JOHN CRANE Packings.

Also, packings for every refining, producing and pumping installation, including hot tars, ammonia and crudes.

Send stuffing box dimensions in ordering, and describe equipment.

1808 Cuyler Avenue Chicago.

Crane Packing Company

2601 Knight Dallas.

PACIFIC MILL & MINE SUPPLY CO., 616 Mission St., San Francisco 310 E. Third St., Los Angeles

W. H. STEIGERWALD COMPANY, 617 Washington St., Houston

CASPER SUPPLY COMPANY, Casper, Wyoming

tinuous maintenance bill, and an ever-diligent watchfulness and attention.

I hope that I have not made anyone present feel that the most important thing in connection with the successful manufacture of gasoline is good water and scale prevention. I am afraid that anyone reading a paper at a conference or convention is apt to feel that the most important paper and the most important subject is his paper and his subject.

And yet, I confess, that I have wanted to point out, in no mistaken terms at least, my own belief that no one detail in connection with the construction and operation of a gasoline plant deserves more consideration on the part of the designer, and him upon whom it devolves to project the plant. Study all the possible sources of water; study that water, and if an analysis points to encrusting solids, before deciding on which source you will definitely provide, do not only ascertain the initial cost but take a look down the line of years and see the ultimate cost. Do not, for the sake of a few thousand dollars, force upon your plant the burden of monthly expense that, in the last analysis, eats into the very foundations of your profits.

Remember, when making your investments, that good water is your best friend; that bad water is the arch enemy of our industry.

Study of Nitrogen Compounds In Petroleum

By J. R. Bailey

(From the committee on the Chemistry of Petroleum, National Research Council)

A REVIEW of the work that has been carried out on the nitrogen compounds in petroleum is a task that does not involve much labor because of the little that has been achieved in this field. Another problem undertaken—one that has developed unusual interest—is to suggest methods that may be introduced into the nitrogen chemistry of petroleum with the ultimate aim of (1) isolating, (2) identifying and (3) synthesizing these nitrogen bases. It is obvious that the isolation and orientation of the nitrogen compounds in petroleum, although by no means simple, is much less complicated than that involved in the petroleum hydrocarbons.

A wealth of material is assured the chemist for the most comprehensive investigation of this phase of petroleum chemistry because, as mentioned further on, the nitrogen compounds in the oil from a well in Santa Paula, California constitute 30 per cent of the whole. If this source of material is still available, it will furnish a supply of intermediates which, to say the least, will act as a stimulus to the research chemist, accustomed as he is to treasure his compounds in grams or fractions thereof.

Whether it will develop in the exploration of this virgin field of nitrogen compounds that petroleum from different sources is quite uniform as respects the families the bases it contains, remains to be seen. An answer to this question, which we may confidently await, may ultimately have some weight in harmonizing geologists on a theory of the origin of petroleum. Furthermore, it is not at all improbable that the chemist will discover some structural relationships between the nitrogen compounds and the hydrocarbons occurring here.

The most recent bibliography of the nitrogen compounds in petroleum that has come to the attention of the writer is in "Wissenschaftliche Grundlagen der Erdoelverarbeitung von Dr. Leo Gurwitsch. Zweite Auflage, Verlag von Julius Springer, Berlin, 1920." As is to be seen from the following quotation from this monograph, page 103, the per cent of nitrogen compounds varies within very wide limits. "As in the case of sulfur, the nitrogen content of most petroleums is very small; the German petroleums appear to be substantially free from nitrogen. Kraemer und Boettcher, Ber., 20, 599 (1887). The Caucasian oils, according to Beilby (Journ. Soc. Chem. Ind. 10, 120 (1891) contain 0.05 per cent nitrogen; the Roumanian oils 0.09 to 0.12 per cent, the Pennsylvania oils only 0.008 per cent, etc. The petroleums of Japan, Ohio and certain California oils are rich in nitrogen compounds and in the latter Mabery, (Ibid. 19, 502, (1900)) found as much as 2.35 per cent nitrogen, which corresponds to about 30 per cent of nitrogen compounds." Gurwitsch also gives references to numerous other occurrences of nitrogen bases in petroleum of which he states: "All of these substances appear to be hydrogenated pyridins and quinolines." The same author cites a base very high in nitrogen isolated by Griffits (Bull. Soc. Chim., 25 (3) 725 (1901)) which was identified as pyridine. In addition to pyridine and quinoline bases, and their hydrides, ammonium salts (probably of naphthenic acids) have been identified in petroleum from different sources. Charitschkow (Journ. Russ. Phys. Chem. Soc., 1906, 1275) proved the presence of methylamine in a petroleum from a deep well at Grosney.

An investigation of the nitrogen products in petroleum is of such a scope and so involved in experimental difficulties as to require a chemist highly skilled in the technique of organic research. It is especially important that the analytical work here be in the hands of a person experienced in both macro and micro combustion analysis because, unless the greatest refinement is attained in carbon, hydrogen and nitrogen determinations, a differentiation between homologues of only slightly differing percentage composition is impossible. As a matter of fact, I can conceive of no line of organic research where the requirements from the analytical standpoint are so exacting or where appreciable errors in combustion work could introduce more confusion. As simple as the analytical side of organic chemistry may appear to the uninitiated, it is my opinion that a student is rarely met with in chemistry who can be depended on for exactness in combustion analysis.

Attention is here directed to a new and accurate method of determining carbon by explosion of the sample with compressed oxygen, a method that has proved very serviceable especially in the case of substances that are difficult to burn (Wilde and Lochte, J. A. C. S. 47, 440 (1925)). Such a control process should prove especially welcome as a supplement to the carbon determination by combustion, although it is apparent that the hydrogen estimation is the one demanding the greater accuracy because of the probable narrow percentage range of the hydrogen content of all the nitrogen compounds in petroleum.

An outstanding contribution on the chemistry of petroleum is "The Constitution of the Organic Nitrogen Bases of California Petroleum," by C. F. Mabery and I. G. Wesson (J. A. C. S., 42, 1014 (1920)). Our slight previous knowledge of the nitrogen compounds in petroleum is summarized by the authors as follows:

"They form illy-defined precipitates from acid solution with platinum, palladium, mercuric, cadmium and ferric chlorides, potassium dichromate, ferro- and ferricyanides, and picric and oxalic acids. By oxidation with potassium permanganate in alkaline solution, the nitrogen of the bases is evolved in part as ammonia and in part as free nitrogen. Oxidation with chromic acid forms free nitrogen and, in some cases, a small amount of acetic acid. Ethyl iodide adds to the bases, if heated with them in a sealed tube. The bases are volatile with steam; they have an odor variously described as 'pyridine', 'quinoline,' and 'nicotine like'; they possess rather weakly basic qualities; and,

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while nearly immiscible with water, they dissolve readily in alcohol, ether, benzol, carbon disulfide, etc."

Mabery and Wesson, after describing the methods of isolation of a mixture of nitrogen bases through the ordinary method of their conversion to water soluble sulphates, states: "The final main fractions obtained by distillation under 50 to 90 mm. pressure, were, according to analysis and molecular weight, determinations as follows":

"Fraction 130-40° as $C_{12}H_{17}N$.
Fraction 197-99° as $C_{13}H_{15}N$.
Fraction 209-11° as $C_{14}H_{19}N$.
Fraction 215-17° as $C_{15}H_{19}N$.
Fraction 223-25° as $C_{16}H_{19}N$.
Fraction 270-75° as $C_{17}H_{21}N$."

A very conclusive proof that the nitrogen bases in the above fractions represent in the main mixtures of homologous series of quinolines or isoquinolines with the nitrogen containing ring completely alkylated and differ from one another (1) in the nature and position of alkyls on the benzine and pyridine nuclei, or (2) in the state of saturation of the cyclic complexes, is afforded by the formation of pyridine pentacarboxylic acid in permanganate oxidation of the various fractions. "This product was examined with little hope at first that it would represent an individual product of the oxidation. When prepared, however, from the basic fractions of the most varying range and with quite radical modifications in the conditions of the reactions, quite the same analytical values were obtained." The isolation of this product, especially if quantitative relations were established, is of fundamental importance in orientation.

Unfortunately, Mabery and Wesson overlooked the existing literature on this substance (Hantzsch, Ann., 215, 62 (1882); Weber, 241, 15 (1887); Ostwald, Z. physik. Chem., 2, 903 (1888); 3, 903 (1889); where is to be found a description of the free acid and numerous salts. They simply identified the acid through isolation and analysis of its silver salt, which is reported as anhydrous, whereas Weber found it to contain two molecules of water of crystallization. It is, of course, possible that the water of crystallization was previously expelled in the samples analyzed, but, if so, no mention is made of the fact. As pyridine pentacarboxylic acid can be obtained from Hantzsch's well-known dihydrocollidine dicarboxylic acid ethyl ester by permanganate oxidation, it would be a comparatively simple matter to institute a direct comparison of the acid prepared in this way with the Mabery and Wesson compound.

Mabery and Wesson's efforts to prepare the free pyridine pentacarboxylic acid yielded only "semi-liquid or amorphous products." Hantzsch obtained it in the form of a "Mass of microscopic needles. * * * After dehydrating at 120° it blackens at 200°, and is completely decomposed at 220°, without melting."

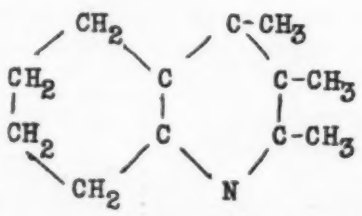
Mabery and Wesson, by restricting the amount of permanganate used in their oxidation, also obtained a methyl pyridine tetracarboxylic acid in the form of its silver salt. They failed to note the existence in the literature of 4-methyl-2, 3, 5, 6-pyridine tetracarboxylic acid (Hantzsch Ann. 215, 57 (1882); 322, 376 (1902). This picoline derivative can be obtained in the free state "in small but well formed glistening prisms," which after dehydration, melt at 199° with violent decomposition. A comparison of the Hantzsch product with the one obtained from the oxidation of petroleum bases would prove of interest.

On oxidation with chromate mixture of the petroleum bases, Mabery and Wesson obtained an oil which formed a picrate melting at 187°. They state: "This is in all probability the picrate of B-methyl quinoline." A melting point in the absence of analytical data furnishes a rather unsafe criterion in the identification of organic substances. Therefore, some elaboration of this phase of the Mabery-Wesson work is desirable because the question is yet to be answered as to whether petroleum bases contain quinolines, isoquinolines, or mixtures of both.

In the rectification of the basic constituents of the Santa Paula oils, as shown above, Mabery obtained a fraction boiling at 130-140° under 50-90 mm. pressure which, according to the analytical data and molecular weight determination, corresponded to the formula $C_{12}H_{17}N$. Mabery states: "In the lowest fraction, $C_{12}H_{13}N$ (probably intended for $C_{12}H_{17}N$), since 3 side chains must be present, these must consist of 3 methyl groups, as the quinoline radical itself accounts for 9 out of 12 carbon atoms." Evidence that the pyridine nucleus is not hydrogenated is furnished in the following quotations:

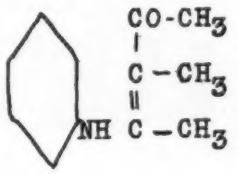
"Ethyl iodide adds to the bases, if heated with them in a sealed tube."
"Reduction of the bases converts the tertiary atom into a secondary one."

Assuming that the fraction referred to in the preceding paragraph consists largely of a compound of the formula $C_{12}H_{17}N$, the most probable structure to be deduced from the data furnished by Mabery is:

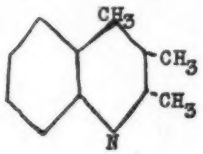


i. e., 7, 8, 9, 10-tetrahydro, 2, 3, 4-trimethyl quinoline.

Although Mabery assumes the presence of three methyl groups on the pyridine nucleus, he fails in this connection to refer to 2, 3, 4-trimethyl-quinoline prepared by Combes (Bull. Soc. Chim., 3 49, 91 (1888); Compt. rend., 106, 142 (1887)) in accordance with the following series of equations:



$C_6H_5\ NH_2 + CH_3CO\ CH(CH_3)COCH_3$



Hollins (Synthesis of Nitrogen Ring Compounds (1924) p. 267) states in connection with the Combes synthesis:

"Diketones, such as acetyl acetone, react with aryl amines to give unsaturated amines readily convertible into quinolines by means of conc. H_2SO_4. This reaction was first used by Combes and is the best method of preparing 2, 3-dimethyl quinolines (Fischer, Scheibe, Merkel and Miller, J. Prakt. Chem., 100, 91 (1919.; v Brown, Gmelin and Schultheiss, Ber., 56, 1346 (1924)." As indicated above, it is also applicable to the preparation of 2, 3, 4-trialkyl quinolines, while its possible extension to the preparation of quinolines, alkylated in the benzene as well as the pyridine nucleus, is obvious.

Although the presence of 7, 8, 9, 10-tetrahydro 2, 3, 4-trimethyl quinoline in the fraction of the composition $C_{12}H_{17}N$ can not be regarded as definitely established, such a speculation is at least interesting because this tetrahydride should be accessible through reduction of Combes' 2, 3, 4-trimethyl quinoline. According to von Braun, Gmelin and Petzhold (Ber., 57, 382 (1924)), the loading of the pyridine nucleus in quinoline with alkyls directs the primary addition of hydrogen on to the benzene nucleus; on the other hand alkylation of the benzene nucleus favors hydrogen addition on the pyridine nucleus. Skita (Ber., 49, 1598 (1916)) in catalytic reductions with colloidal platinum, found that "As with benzol and its derivatives, the catalytic reduction of the pyridine and quinoline nucleus is increasingly difficult, as the number of substituent groups increases. Although pyridine is easily hydrogenated, picolin is much less so, and this difficulty is greatly increased in the case of lutidin and collidin. Similar relations hold in the case of quinoline and its derivatives." Skita found, how-

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ever, that a temperature of 50° in all cases greatly facilitated the reduction.

Mabery and Wesson, from their research, conclude that only the lower alkyls, three of which are invariably attached to the pyridine nucleus, function as substituents in the petroleum quinoline bases. The formulas assigned the different fractions indicate, what is not at all improbable, that the more highly alkylated bases to be found here are not hydrides of quinoline. The question, therefore, presents itself: Are the nitrogen bases in petroleum a mixture of aromatic and hydroaromatic compounds?

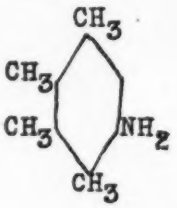
On the assumption that the Mabery-Wesson bases are alkylated quinolines or their hydrides with the pyridine nucleus completely alkylated, the question as to the nature of these alkyls presents itself. Very important evidence in this connection is furnished by the fact that "None of the alkyl groups represents a long side chain (more than 4 carbon atoms), even in the bases of high molecular weight, as indicated by the absence of propionic, butyric, or higher fatty acids in the oxidation products." Methyl is the common alkyl in nature; e. g. ethyl has not been found as an alkaloid alkyl. It is true that isopropyl along with methyl substitutes in the benzene nucleus of cymene and many of the related terpenes, but, where the pyridine or quinoline complexes are found, if alkylated, they are methylated.

The formulas assigned the different fractions can well correspond to methyl quinolines or their hydrides with the exception of the $C_{17}H_{21}N$ fraction. When it is considered that none of these fractions are claimed to represent pure chemical substances, it is not at all improbable that the nitrogen compound in Santa Paula petroleum with the highest molecular weight is heptamethyl quinoline of the formula $C_{16}H_{21}N$. A comparison of the percentage compositions of $C_{16}H_{21}N$, $C_{17}H_{21}N$ and $C_{17}H_{23}N$ follows:

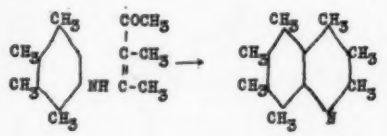
	C%	H%	N%	M.W.
$C_{17}H_{23}N$	84.65	9.54	5.81	241
$C_{17}H_{21}N$	85.35	8.79	5.86	239
$C_{16}H_{21}N$	84.58	9.25	6.17	227

It is evident that the formula $C_{17}H_{21}N$ assigned to Mabrey and Wesson's highest boiling fraction, because of the hydrogen deficiency, does not represent a quinoline with 17 carbons. Therefore, without further purification no decision can be reached between $C_{16}H_{21}N$ and $C_{17}H_{23}N$ as the most concordant formula for the main quinoline constituent in this fraction. That an alkyl quinoline at least alkylated in the 2, 3, 4-positions, is present, follows from the results obtained in the permanganate oxidation. $C_{15}H_{19}N$ and $C_{14}H_{17}N$,, the respective formulas of the two fractions below the higher one discussed above, also lend encouragement to the isolation of heptamethyl quinoline.

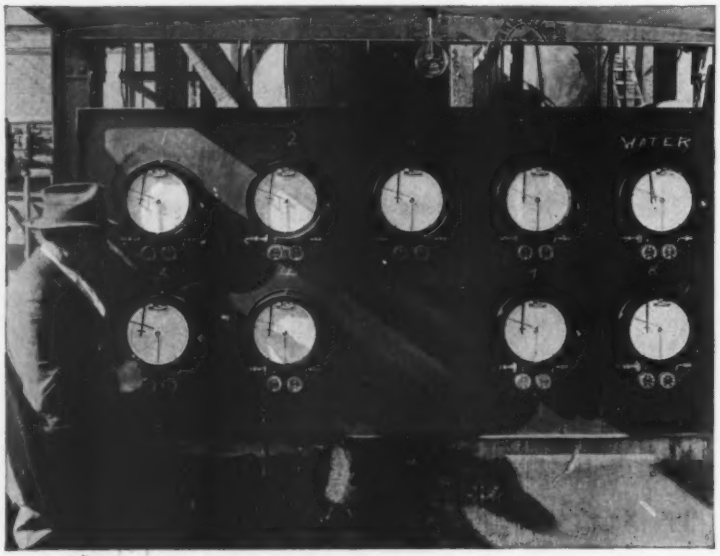
Because there can be only one heptamethyl quinoline, its synthesis becomes highly interesting in connection with the nitrogen chemistry of petroleum. The logical procedure to be employed—one involving an application of the Combes' reaction—is suggested by the following equations:



(Ber. 21, 644, 905 (1885))+$CH_3COCH(CH_3)COCH_3$—



Heptamethyl quinoline of all the possible methylated quinolines might be expected to offer the greatest resistance to reduction. Added interest, therefore, is attached to this proposed synthesis because a study of heptamethyl quinoline would extend our knowledge of the influence of progres-



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sive alkylation on the reduction of heterocyclic compounds.

Myberry and Wesson carried out a reduction of "22 g. of Base 164-166" by the use of mossy tin and conc. hydrochloric acid. * * * The most constant fraction (obtained) 208-210° at 90 mm., was a light, reddish brown, rather mobile oil. Analyzed for the carbon and hydrogen content, it gave:

		H	N(diff.)
"No. 1	83.30	9.81	....
No. 2	82.52	9.66	....
Average	82.94	9.74	7.32"

"This composition corresponds nearly to that of an alkylated quinoline, $C_{14}H_{17}N$, plus 3 or 4 hydrogen atoms. Thus, the calculated composition of the latter would be:

	C	H	N
"For $C_{14}H_{21}N$ ...	82.75	10.35	6.90
For $C_{14}H_{23}N$ ...	83.16	9.91	6.93
The product analyzes as	82.94	9.74	7.32"

It should be noted that the nitrogen in the reduced fraction was calculated by difference. The absence of a combustion analysis for nitrogen here is to be considered an omission of very great importance because this determination would furnish a check on the carbon and hydrogen per cents found.

"That reduction has taken place upon the nitrogen ring and upon the nitrogen atom is strongly indicated by a comparison of the actions of nitrous acid upon the basic fractions before and after treatment with nascent hydrogen." On benzoylation of the reduced fraction "a reddish gum of a sweetish odor" was obtained.

The reduction of the different fractions of nitrogen bases that can be obtained from Santa Paula petroleum will undoubtedly play an important role in any comprehensive investigation aimed at identifying the different products involved here. If substances are present, which differ merely in their state of saturation, the complexity of the fractions might be simplified by exhaustive hydrogenation. Furthermore, if Mabery and Wesson are correct in the assumption that the bases in Santa Paula petroleum are tertiary, and that reduction "converts the tertiary atom (N) into a secondary one," reduction would result in the formation of a reactive imino group.

Mabery and Wesson found in using tin and hydrochloric acid "that in the reduction process some of the base escaped action because of the formation of an insoluble double compound of tin chloride and base hydrochloride." This difficulty could be entirely eliminated by employment of the well-known Skita method, with the added advantage that the hydrogen consumption in this catalytic method of reduction can be followed at every stage of the reaction: both the reduced and unreduced bases would be held in solution as salts. Furthermore, it is not inconceivable that the different fractions would be found to consist of a mixture of bases of which some would be more readily hydrogenated than others; if so, partial reduction could be employed as a means of separation. It should be noted, however, that any material employed in this form of reduction must be free of sulphur compounds because of their toxic action on the catalyst.

E. B. Maxted (Catalytic Hydrogenation and Reduction. (1919) pp. 57-58), states: "Quinoline by treatment with hydrogen at the ordinary temperature in acetic acid solution in the presence of colloidal platinum passes successively into tetra and decahydro reduction products, the pyridine nucleus being attacked before the benzene ring. * * * Isoquinoline, on the other hand, has up to the present only been hydrogenated to the tetrahydro derivative." An important phase in the investigation of the nitrogen bases in petroleum would be the determination of what might be termed their "hydrogen number," because it is possible that the reduction of these products might in some instances stop at the tetrahydride, while in others it might be carried on to the dekahydride.

The formulas assigned the different fractions of nitrogen bases from Santa Paula petroleum by Marbery and Wesson indicate, what is not at all improbable, that the bases of lower alkylation are hydrides of alkyl quinolines, whereas the bases of higher alkylation are entirely aromatic in character.

Ring cleavage of (1) the benzene nucleus and (2) the pyridine nucleus will doubtless prove of great value in orientation of the individual quinoline bases in petroleum, since in this way information may be gained regarding the relative distribution of the substituting alkyls.

Permanganate oxidation in alkaline solution is the common method of carrying out cleavage of type (1), and, as discussed above, Mabery and Wesson obtained by this process from different fractions of their nitrogen bases impure pyridine pentacarboxylic acid.

A summary of the most important methods of effecting cleavage of type (2) is given in "Die Methoden der Organischen Chemie" (Houben - Weyl, vol. iv., p. 518, 1924)). "The methods for ring cleavage arrange themselves according to the nature of the cyclic base and particularly as to whether a secondary, tertiary or quaternary base is present. The most important methods are:

"1. Secondary Bases:
The cleavage with phosphorous pentahalides, according to V. Braun.

"2. Tertiary Bases:
(a) The bromcyanogen method of V. Braun.
(b) The hypochlorite method of Willstaetter.
(c) The chlorocarbonic ester method of Godamer.
(d) The azidocarbonic ester method of Diels.

"3. Quaternary Bases:
(a) The Hoffman decomposition.
(b) Splitting by reduction.

"4. Various methods of ring cleavage."

Mabery and Wesson applied the Von Braun method to the benzoylation product of "Base 164-166°, which had been reduced by nascent hydrogen," but "no pure product could be crystallized out and identified." As each quinoline base present in a mixture, such as the different fractions of petroleum bases doubtless represent, would be expected to yield a distinct product in applying the Von Braun reaction, it is not surprising that only negative results were obtained in this phase of the Mabery-Wesson research.

In the opinion of the writer, very little advance will be made in the chemistry of the nitrogen compounds of petroleum until methods are worked out for isolating in the pure state the individual compounds occurring here. The futility of relying solely on fractional distillation for this purpose requires no comment because of the apparent complexity of the mixtures to be dealt with. Fractional distillation as a "first aid" treatment is of value. Furthermore, fractional crystallization of the salts of these bases, such as the chloroplatinates picrates, etc., can not be expected to prove of great value.

Willstaetter's work, and later Werner's, on the separation of organic bases referred to below, suggests methods of attacking the problem that are certainly worthy of trial.

E. A. Werner (J. Chem. Soc., 113, 900 (1918)) in connection with the separation of primary, secondary and tertiary ethyl amines, states: "A fair separation of all three amines * * * has been effected by fractional treatment of a solution of their salts with sodium hydroxide; the tertiary amine was first liberated, the secondary next, and the primary last. It must be admitted that these results go to show, contrary to the commonly accepted view, that triethylamine is the weakest base of the three amines."

Werner (Ibid, 115, 1012, (1919)) later employed partial neutralization with hydrochloric acid as a means of separating (1) secondary and tertiary butyl amines, and (2) primary and secondary butyl amines. It is interesting to note that "The separation by fractional distillation was abandoned as hopeless. * * * The separation" by partial neutralization, "was complete."

Willstaetter in his classic research on chlorophyll, also employed a similar principle with great success, as is shown in the following quotation (Untersuchungen. Ueber Chlorophyll — Willstaetter und Stoll, ((1913), p. 14): "Clear information regarding mixtures

of variable composition, such as are obtained in the first steps in the decomposition of chlorophyl, if we had not had a method for separating, determining and differentiating between the basic chlorophyl decomposition products. The method never failed to give satisfactory results. The mtehod developed by Willstatter and Mieg (Ann. 350, 1, (1906)), is based upon the different distribution of these coloring matters between ether and dilute hydrochloric acid." Willstatter's separation was based on the observation that, depending on the ease of hydrolysis of its hydrochloride, each of the bases involved in mixtures required hydrochloric acid of a definite concentration for extraction from ether solution. The concentration of acid required gives the "hydrochloric acid number" of any particular base.

It is highly improbable that the mixture of bases in any of the different fractions prepared by Mabery consist of a single series of compounds. We can rather assume—granted quinoline bases predominate—that admixtures of various types of nitrogen compounds are present. (1) Fractional precipitation of the bases from the mixture of salts that salification of any particular fraction would yield, or (2) step-wise neutralization with a mineral acid of the bases contained in the different fractions would undoubtedly prove valuable aids in separating and identifying individual components. It is also highly probable that the hydrochloric acid numbers of the different bases in the separate fractions would differ over a sufficiently wide range to render the Willstatter method serviceable. The simplicity of procedure in these methods would reduce the loss of material to a minimum, and there is no prabability that complications would be introduced by side-reactions.

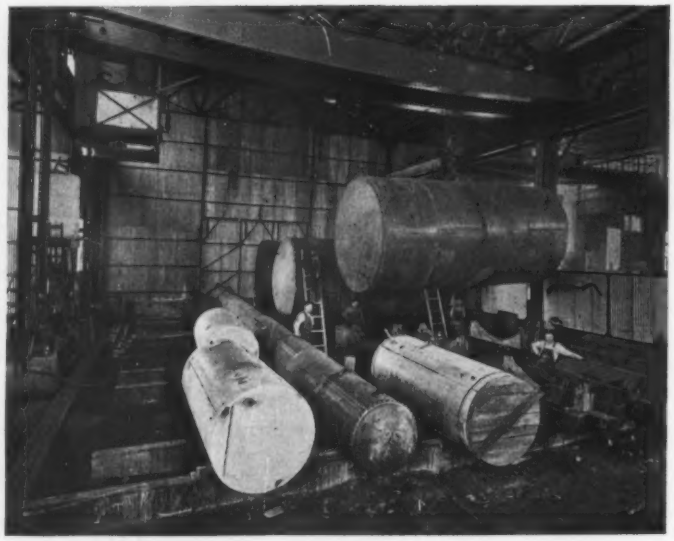
A systematic and detailed discussion of quinoline compounds and their hydrides is presented in "Lehrbuch der Organischen Chemie"—Meyer and Jacobson — Zweiter Band, Dritter Teil, pp. 912-1003 (1920). The very comprehensive bibliography found here will be of considerable assistance to the chemist interested in this field.

A reference to the work of V. H. Vely (The Affinity Constants of Bases as Determined by the Aid of Methyl Orange, J. Soc. Chem. 93, 2122, (1908)) is of especial interest because of the information furnished with respect to the influence of (1) alkylation and (2) progressive hydrogenation on the basiscity of quinoline. Vely found for quinoline hydrochloride: "Hydrolysis value= 2-methylquinoline hydrochloride: "Hydrolysis value = 30.2; hence kb ($_{18}$) = 15.6; hence kb ($_{18}$) = 1.63 10^{-9}." For 3.62 10^{-10}; this base is therefore weaker than quinoline." For tetrahydro quinoline hydrochloride "No hydrolysis could be detected even in concentrated solutions." As regards dekahydro quinoline, Meyer and Jacobson, p. 950, state: "It dissolves freely in water, reacts strongly alkaline, fumes in the air, and rapidly takes up carbonic acid from the air; as a result of this strongly basic character, it can be extracted from its solution in ether by shaking with dilute acetic acid; this is a property which can be utilized to separate it from the much less basic tetrahydro and hexahydro derivatives. The decahydro derivative possesses the character of an aliphatic amine."

The following quotation from Meyer and Jacobson, p. 946, is of interest because methods are suggested for the dehydrogenization of quinoline hydrides. "Relatively smooth reconversion (of tetrahydro quinoline) to quinoline results on heating with nitrobenzol (Lellmann, Reusch, Ber., 22, 1390, (1889)) and with iodine (E. Schmidt Ar. 237, 563, (1899)) very easily with concentrated mercuric acetate solution at 130-150° (Tafel, Ber., 25, 1620-1622 (1892); see also Ber., 27, 824, (1894))"

Another excerpt of interest (p. 946) in connection with any reduction of petroleum bases that may be isolated follows: "The reaction of methyl iodide on tetrahydroquinoline is very vigorous and easily passes beyond the formation of the tertiary amine to the quaternary dimethyl tetrahydro quinoline iodide."

Owing to the immense supply of nitrogen compounds in California petroleum, their possible exploitation in commercial organic synthesis gives increased interest to this phase of the



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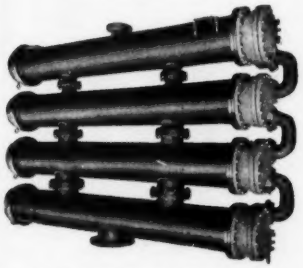

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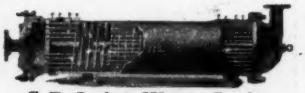

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chemistry of petroleum. The methyl quinolines are employed in the manufacture of what are known as the "Cyanine Dyes," which Meyer and Jacobson (p. 1000) arrange under three families:

"(a) Apocyanines: red to yellow coloring matters derived from the halogen alkylates of quinoline; their aqueous solutions are not instantly decolorized by mineral acids."

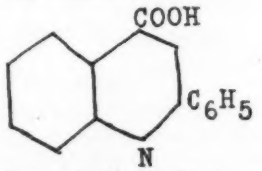
"(b) Isocyanines: red coloring matters, derived from alpha methyl quinoline; their aqueous solutions are instantly decolorized by mineral acids."

"(c) True Cyanines: blue coloring matters, derived from gamma methyl quinoline; their aqueous solutions are instantly decolorized by mineral acids."

The practical value of these dyes is brought out in the following quotation from Meyer and Jacobson (p. 1002): "The extreme sensitiveness to light of the cyanine dyes render them of no value as dyestuffs. But they find interesting applications in photography, since Miethe and A. Traube observed in 1903 that as a result of their sensitiveness, which is greater in the orange zone of the spectrum than all other sensitizers, it is possible to prepare panchromatic dry plates which have almost uniform sensitivity over the whole visible spectrum. Particularly valuable is the dye 'ethyl red,' made from the ethyl iodide derivative of quinoline and quinaldine. Related sensitive dyes have come into the trade under the name of pinachrome." (See Meyer and Jacobson for numerous literature references).

Although the investigation of Mabery and co-workers on the nitrogen bases in petroleum will not warrant conclusions of a far-reaching nature as to the exact structures of the quinoline bases occurring here, it is highly probable that California petroleum can be made to furnish a cheap source of highly alkylated quinolines, very few, if any, of which are known. Should economical methods be perfected for isolating any of these substances in quantity and in a comparative state of purity, it is reasonable to assume that the nitrogen compounds in petroleum will ultimately find application as intermediates in the manufacture of new dyes.

A pharmacological examination of any nitrogen compounds that may be found in petroleum will be of scientific interest. However, it is not to be expected that any great intrinsic value will accrue to California petroleum from this source. A quinoline derivative of the structure,



possessing valuable analgesic properties, is sold under the name "Atophane" and finds quite extensive use in medicine. Meyer and Jacobson (p. 1008) state: "The result of the discovery of atophane and its value as a drug has been the synthesis of a large number of salts, derivatives, homologs, and analogous substances" (For the very extensive journal and patent literature in this connection the above reference should be consulted). "Novatophane," and more recently "Hexophane," quinoline derivatives of the atophane type, may be mentioned.

Plant Soon Ready

Wichita, Kans.—The plant of the West Kansas Refining Company, in Russell County, will soon be operating, according to announcement of Clinton H. Montgomery, president. The offices of the concern will be maintained here. Refined products will be sold by the Refiners Consolidated Sales Company, with the exception of gasoline and kerosene, which will be handled by the Derby Oil Company.

Burrell Catalogue Out

Catalogue J of the Burrell Technical Supply Company, Pittsburgh, Penna., is off the press and will be forwarded to interested persons in the oil industry.

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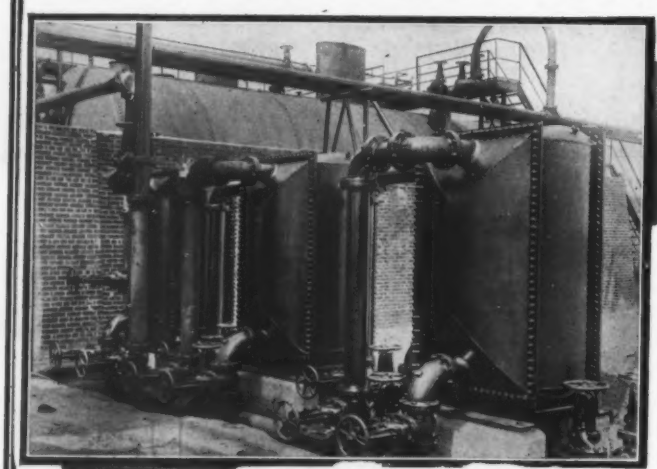

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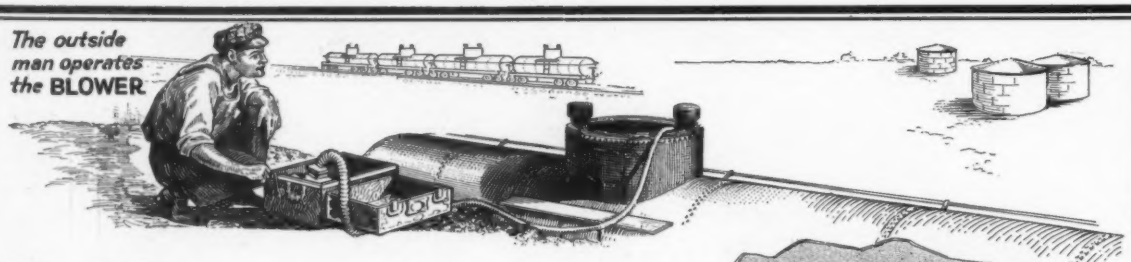

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RECENT REFINERY PATENTS

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the refining industry were granted by the United States Patent Office during August:

No. 1,548,400, granted August 4 to Frank A. Walker, Wichita Falls, Texas, assignor of one-half to Cletus C. Connolly, Wichita Falls, Texas, for a sediment collecting and clean-out device for storage tanks, comprising the combination with a tank provided in its bottom with an opening, of a frusto-pyramidal pan located beneath the opening, a discharge pipe extending downwardly from the center of the pan, a baffle plate within the tank above the opening, and of a size to project beyond all the edges of the opening, a plurality of bolts passing through the baffle plate, the tank bottom and the pan edges for securing the pan in place and holding the baffle plate, and sleeves surrounding certain of the bolts and interposed between the bottom of the tank and the baffle plate for maintaining the latter in spaced relation to the bottom of the former.

No. 1,548,992, granted August 11 to Richard W. Hanna and Joseph F. Brooks, Richmond, Calif., assignors to Standard Oil Company of California, for a process of treating lamp oil distillates with sulphuric acid, which comprises heating the oil to a temperature approximately 200 degrees F., continually forcing together the oil and acid in a conduit closed from access to the atmosphere, and conducting away the heat of reaction from the intermingled oil and acid at a rate sufficient to maintain the mixture at approximately 215 degrees F.

No. 1,549,352, granted August 11 to Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Company, Chicago, for an oil conversion process consisting in heating a stream of oil to a cracking temperature, in delivering the oil to one of enlarged alternative chambers, in diverting the stream of oil from said chamber when substantial coke deposition has occurred therein to the alternative chamber, and in heating said alternative chamber before diverting the oil stream by heating a body of oil introduced thereto by applying external heat to said alternative chamber.

No. 1,549,469, granted August 11 to Albert Ernest Dunstan, Sunbury-on-Thames, England, for a method of refining mineral oil and distillates thereof comprising treating the oil with an aqueous solution containing hypochlorous acid, distilling a portion of the treated oil to produce a distillate substantially free from impurities and reaction products, and removing the reaction products from the residuum of the distillation by treatment with an absorbent material.

No. 1,549,569, granted August 11 to Gustave C. Bevan, Indiana Harbor, Ind., assignor of one-half to Roy C. Clark, Indiana Harbor, Ind., for a valve for tanks, comprising in combination with an outlet spout, of a casing provided with a tapered bore gradually increasing in diameter toward the bottom of the bore, said casing provided with a pair of diametrically opposed openings in its sides, a valve plug rotatable in said bore and provided with passageways adapted to communicate with said openings and said outlet spout, a plurality of circumferentially spaced radial lugs formed on said outlet spout, and a spring supported by said lugs and engaging said valve plug.

No. 1,549,770, granted August 21 to Will E. Holmes, Tulsa, Okla., assignor to The Texas Company, New York, for a gas-tight dome cover consisting, in combination with a tank car dome, of a removable dome cover having a plurality of radial extensions on its periphery, each extension having a notch on one radial edge thereof, mean adapted to engage said notches for securing the cover to the dome, a protector head adapted to be disposed above the dome cover, a horizontally disposed flange integral with the protector head having a plurality of radial extensions, each extension having a notch on one radial edge thereof, and means co-operating with the notches for securing the protector head to the dome.

No. 1,549,894, granted August 18 to Joseph E. Adams, Flatbush, N. Y., assignor to The Texas Company, Houston, Texas, for an oil-converting apparatus dome comprising a dome provided with a lower liquid cistern, an upper vapor space and an intermediate overflow chamber, communicating connections between the lower liquid cistern and the vapor space, and also between the vapor space and said overflow chamber, an inlet for supplying oil to said liquid cistern, from whence it passes upwardly into said vapor space and thence downwardly into said overflow chamber, an outlet to carry off the vapors separated from the oil in said vapor space, an outlet for removing the oil from said overflow chamber, and a chamber below and in communication with said liquid cistern for receiving the residue settling out of the oil therein.

No. 1,550,115, granted August 18 to Arthur D. Smith, Arkansas City, Ark., for a process of treating heavy hydrocarbons, which consists in cracking the same, filtering the remaining liquid to remove the larger particles of free car-

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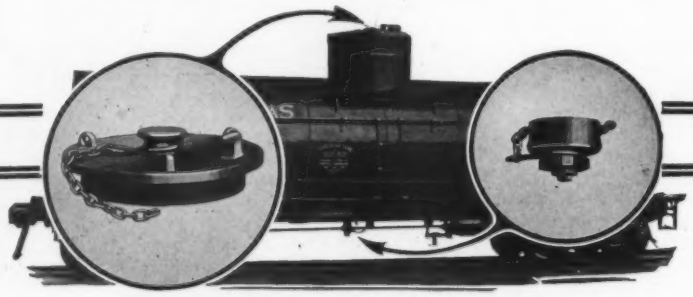

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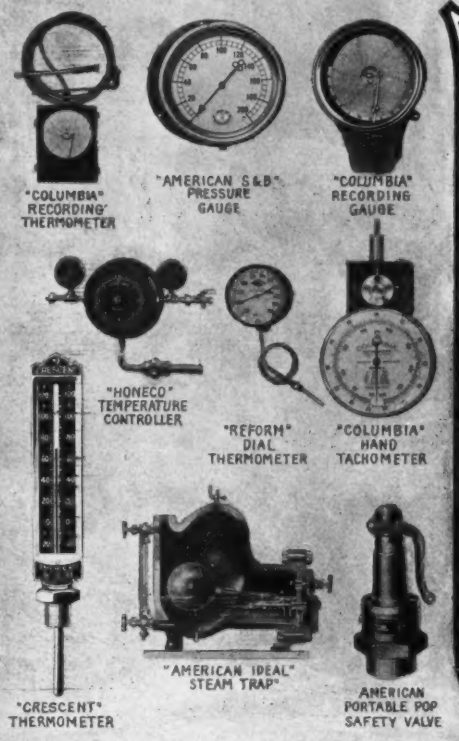
bon, then subjecting said liquid to centrifugal action to eliminate a portion of its colloidal carbon, and then returning said liquid to the cracking zone.

No. 1,550,523, granted August 18 to Egon Eichwald, Hamburg, Germany, for a process for purifying hydro-carbon like oils or their admixtures, with organic solvents, consisting in adding a quantity of a substance containing furfurol to the oils and intimately mixing it therewith, allowing the mixture to stand and separating the layer of the substances containing furfurol from the remaining portion.

No. 1,550,568, granted August 18 to Robert T. Pollock, Boston, assignor to Universal Oil Products Company, Chicago, for a process for converting oil, comprising passing a restricted stream of oil through a heating tube where said oil is heated to a cracking temperature, in transforming the highly heated oil to an enlarged zone where conversion occurs, in passing vapors generated from the oil to a dephlegmator, in introducing charging oil to the dephlegmator to pass therethrough while in indirect heat conductive relation with the vapors to be maintained out of physical contact with the vapors, and to assist in condensing the insufficiently cracked vapors undergoing dephlegmation, in collecting the condensate in pools in the dephlegmator, through each of which pools the vapors must percolate, and with which condensate said preheated charging oil is not permitted to physically commingle in the dephlegmator, in preventing the return of unvaporized residue from the enlarged zone to the heating tube, in passing reflux condensate and preheated charging oil from the dephlegmator to the inlet side of the heating tube, to travel therethrough for treatment, and in maintaining a superatmospheric pressure on the oil undergoing conversion.

No. 1,550,607, granted August 18 to Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Co., Chicago, for an oil conversion process, consisting in advancing a stream of oil through a coil in a heating zone wherein it is subjected to a conversion temperature while maintained under a superatmospheric pressure, in passing the highly heated oil from said stream into an enlarged reaction chamber from which the vaporized oil is permitted to return to said coil, in passing the evolved vapors from said reaction chamber to a dephlegmator, in passing a stream of charging oil in heat interchanging relation with the vapors in said dephlegmator to simultaneously preheat such oil and condense the heavier fraction of the vapors, in advancing a second stream of oil directly to the inlet of said coil, in directing the preheating charging oil and the reflux condensate from the dephlegmator to pressure applying means, and in forcing said preheated oil and reflux condensate under mechanically applied pressure into said advancing second stream of oil to be passed therewith through said coil.



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Panhandle Crude Shows Excellent Gasoline Content

(Continued from page 35)

pressure with the vapor pressure of a current of steam, or by the reduction of the atmospheric pressure by means of a vacuum pump.

Table 1 represents the results tabulated, as obtained by vacuum distillation of Panhandle crude petroleum. The Engler type still used in this experiment gave a yield of 17.5 per cent of 64/66 grade of gasoline and a total yield of 26.6 percent of Navy gasoline of correct end point, taken off the crude in one cut. The lower cuts, those of gas oil and wax distillate, were produced under a vacuum of 28 inches. A study of this table indicates nicely the characteristics of the crude above the cracking temperature.

Engler Distillation

The analysis of Panhandle crude by direct fire, Engler distillation to an 85 per cent vaporization indicates a yield of 16 percent of the 64/66 grade of gasoline, and a total yield of 28 percent of Navy gasoline in one cut. In this experiment the Naphtha was cut rather deep, being 459 degrees F. in end point, but to obtain even such percentage recovery as noted it was necessary to reduce the "cutting temperature", from 410 degrees F.; as in the Hempel distillation, to 400 degrees F. with the Engler. That portion of the oil boiling above the cracking temperature was forced over by applying heat intensely, thus keeping the termometer in ascension. This provides a more uniform curve (Figure 1) and is not difficult to accomplish with small volumes of oil. Table 2 records results of distillates by the Engler method.

Hempel Distillation

Figure 1—Indicates the temperature or distillation curves of Panhandle crude as recorded from the three methods of anlysis. There is greater difference noted in these curves above 600 degrees F. than is noticeable below that temperature. A greater yield of gasoline is recovered under the Hempel methods, dut to proper and efficient fractionation. The Hempel column in this experiment was packed three-fourths full of ⅛-inch glass beads. Nineteen percent of 64/66 gasoline with 372 E.P. was obtained in one direct cut. A total yield of 29 percent of Navy gasoline was received having a final boiling point of 430 degrees F. The kerosene yield was lower in the Engler test by one percent. the kerosene distillate having an initial boiling point of 404 degrees F.

By vaporizing 85 percent of the total crude charge, 42 percent of gas oil was separated from the crude. This is in line with the growing practice among refiners, of vaporizing deep into the crude by pipe still operation, to obtain the maximum of gas oil for charging stock for cracking units. This practice of preparing charging stocks for the cracking units by vaporizing deeply also eliminates the poor grade of fuel oil usually produced by cracking, in that the pipe still residuum is absolutely free of coke and other solid matter. The total percentage of gasoline obtainable from the crude by cracking this large yield of gas oil is easily calculable but figures and estimates must be based upon the method of operating individual cracking units. A yield, however, of 50 percent gasoline from Panhandle crude, to be derived from the crude charged to the refinery by both skimming and cracking, can be easily obtained.

Mettler Patent Allowed On Entrained Gas Burner

Lee B. Mettler of the Lee B. Mettler Company, 405 South Main Street, Los Angeles, Calif., has just been notified by the United States Patent Office that he has been allowed Patent No. 1,539,-093 on his entrained combustion gas burner, which has proven a decided improvement over the surface combustion gas burner, which they have been manufacturing for the past three years.

Mr. Mettler states that this burner was designed with a view of more effectively burning the lighter hydrocarbons, which are now all that is left in the gas after the absorption and compression methods of extracting the gasoline and other heavier hydro-carbons in the natural gas has taken place. The lighter hydro-carbons containing more B. t. u.'s heretofore have required with previous available equipment considerably more excessive air than when the gases contained the heavier hydrocarbons or quicker combustibles.

His system of entraining the air by the gas pressure—both the air and gas being admitted at an acute angle—mixing same in a highly refractory mixing plate, and when brought to the critical point of mixture, firing same, has proven a revelation to all gas combustion engineers.

Due to the small amount of excessive air, the fire produced naturally has a less oxidizing effect to the refractories in the combustion chamber and to the heating surfaces, and allows a higher combustion chamber temperature, which naturally increases the transfer of heat to the heating surface due to the radiant power of same.

He states that he now has over 110,-000 B. h. p. equipped with this improved burner, and while just a few years ago efficiencies of 80 per cent were practically unknown, there are very few recent installations where the boiler and settings were modern but what have not shown by test at least 83 per cent, and in some cases as high as 84 per cent efficiency over boiler, furnace and burners.

The entire burner construction and installation lends itself readily to the insertion of an oil burner in the same combustion chamber, whereby it is then possible to burn either gas or oil separately or at the same time without making any change in the combustion chamber to do so.

He states that in every instance where oil was previously used exclusively, the installation of the gas burner in the same combustion chamber has increased the efficiency of the boiler when burning oil. While this burner was primarily designed for natural gas, he has tested same out in fourteen widely separated small installations, using artificial gas in same, and by tests so far made he states that it is possible to get with this burner a higher efficiency when installed in the ordinary hot water and steam boilers than has heretofore been possible with especially built gas burning boilers.

He will gladly furnish data to any interested parties.

Condenser Piping Bulletin

Simplex cast iron condenser piping is featured in a booklet just published by the American Cast Iron Pipe Company, Birmingham, Alabama.

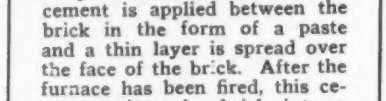
This piping has been developed during the past several years to overcome the difficulties incident to the building of condenser coils with flanged pipe. Simplex pipe is flanged pipe minus the limitations of a joint made with rigid flanges. The booklet is neatly illustrated and gives all details about the equipment it describes.

Copies may be had from the company by writing for "Simplex Cast Iron Condenser Piping."

Breckenridge, Texas.—Another addition to the Phillips Petroleum Company's long list of natural gasoline plants in Central West Texas fields was made during August by the purchase of a 2000 gallon daily capacity plant located at Ivan in upper part of Stephens County from the Gilmore-Parrot Company of Los Angeles for $20,000. The plant was formerly owned by the Rochester Gasoline Company. The new owners have announced that additional gas has been contracted for to permit the enlargement of the plant, which is equipped with the absorption process.

An Authority on Oil Still Construction Says:—

"High temperature cement has to a great extent taken the place of fire clay in recent years, especially where extremely high temperatures are required. This cement is applied between the brick in the form of a paste and a thin layer is spread over the face of the brick. After the furnace has been fired, this cement unites the brick into a solid wall, and forms a glazed surface over the brick, thereby protecting the brick from disintegrating under the extreme heat."



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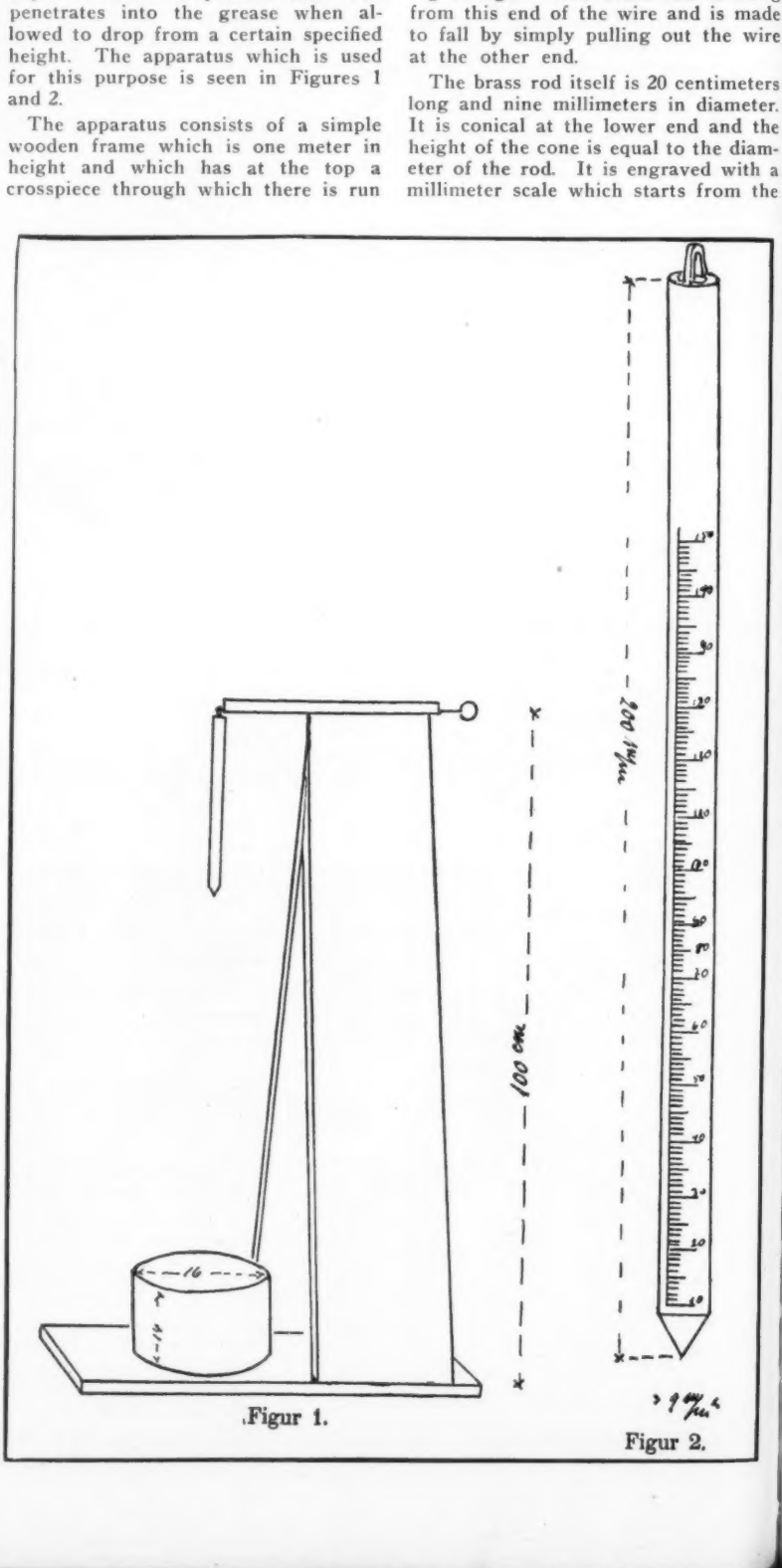
EXTRACTS OF REFINING TECHNOLOGY

Measuring the Consistency of Lubricating Grease.—The consistency of lubricating grease is measured by the depth to which a pointed brass rod penetrates into the grease when allowed to drop from a certain specified height. The apparatus which is used for this purpose is seen in Figures 1 and 2.

The apparatus consists of a simple wooden frame which is one meter in height and which has at the top a crosspiece through which there is run a piece of wire about three millimeters thick, one end of which is bent in the form of a noose and the other end being straight. The brass rod is hung from this end of the wire and is made to fall by simply pulling out the wire at the other end.

The brass rod itself is 20 centimeters long and nine millimeters in diameter. It is conical at the lower end and the height of the cone is equal to the diameter of the rod. It is engraved with a millimeter scale which starts from the



Figur 1. Figur 2.

point of the cone. The rod weighs 50 grams, the weight being adjusted by means of lead shot in the hollow center of the rod. A hook at the end of the rod engages, as mentioned before, with the horizontal brass wire. The wooden base carries a cylindrical box, 14 centimeters high and 16 centimeters in diameter. This box is packed tight with the grease, care being taken to squeeze out all air bubbles.

By withdrawing the supporting wire, the rod is permitted to drop, and the depth to which the rod penetrates the grease is read off the scale on it. The process is repeated by shifting the box of grease so that the rod falls on a different part of the grease each time, but not within three centimeters of the sides of the box. Different readings on the same grease should agree within one to two millimeters. A temperature of 20 degrees Cent. is taken as standard, and the readings at the temperatures are corrected by the addition or subtraction of 0.66 millimeter per degree Cent., below or above 20 degrees Cent., respectively. Care must be taken in reading the temperature of the grease, and the best method is to stir it with the thermometer until a steady temperature is attained. Chem. Umschau, 1925, 115-17.

* * *

Tar Value and Examination of Transformer and Turbine Oils.—The examination of transformer and turbine oils as to their development of alkali soluble tarry matter is likely to give a misleading impression because of the fact that the results that are obtained from such a test do not bear any simple relation to the tendency of the formation of sludge under conditions of use. With progressive increase in the degree of refining, the tar value of the oil decreases to a minimum and then increases again, the reversion being much sharper for paraffin hydrocarbons than for the naphthenes. This subsequent increase in the tar value of the oil is to be attributed to a process of destructive oxidation, whereas the formation of sludge is a process of polymerization of a oxidation character. The former type of oxidation in the oil is accompanied by the formation of peroxide, and the development of active oxygen can be demonstrated by the increase in the copper reducing value and the decrease in the strength of cotton immersed in it. In the absence of definite knowledge as to the substances which are actually responsible for the changes, the only satisfactory course is to base judgment on prolonged tests under conditions which are comparable with those obtaining in actual practice. Zeitschrift fuer angewandte Chemie, 1925, pp. 476-81.

* * *

Continuous Rectification of Hydrocarbons.—The liquid under treatment is vaporized before it passes into the lower end of a rectifying column for fractionation. Vaporization is effect-

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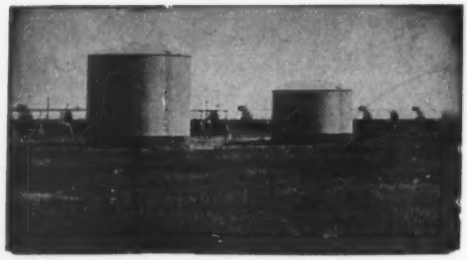

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ed by passing the liquid down the tubes of a vertical tubular vaporizer, high pressure saturated steam at a temperature of 180 to 190 degrees Cent. passing around the tubes. The heavy residues flow out of the bottom of the column, fractions are withdrawn at suitable heights, and uncondensed vapor passes out of the top into a condenser. The vaporizer, fractionating tower and storage tanks for the various fractions are maintained under a vacuum.

In a modified form of apparatus for fractionating liquids which contain constituents, for example, lubricating oils of high boiling point not vaporized by saturated steam, two vaporizers are provided, the first being heated by saturated steam, and the second, which receives the unvaporized residues from the first, by strongly superheated steam. Vapor from the first vaporizer enters the column at a point which is about midway up it, and vapor from the second enters at point near the bottom. (British patent No. 208,175).

* * *

Catalytic Action of Metals on Mineral Oils.—Plates of copper, brass, tin, zinc, aluminum and lead were allowed to remain for a period of 1000 hours in three different grades of transformer oils at an average temperature of 112 degrees Cent. In one test the entire plate was immersed in the mineral oil and in the other only one-half of it was permitted to come in contact with the oil. The slime that is obtained is precipitated with the aid of a light benzine and the acid number of the filtered oil was determined. For control purposes the oil alone was heated and then titrated.

At the beginning the acid number rose, and then after a period of three days had elapsed the acid number remained constant for another three days, during which time the oil became turbid; then the acid number rose until the tenth day, and then decreased during a period of another ten days. During the latter period considerable slime formed. This process of acid formation and oxidation, which is followed by condensation and polymerization, leads to the building of a neutral, insoluble substance, the slime. It was repeated a number of times.

The formation of acid was materially increased by the presence of copper and brass, but the effect of the other metals was not so marked. Aluminum is not attacked by the oil, and on the other hand copper, brass and tin are partly dissolved. Lead acts differently from all the other metals. After the period of 1000 hours has elapsed the oil possessed a pale reddish color, contained no asphaltic substances. Oil soluble acids were formed in appreciable amounts and the acids present in the oil were precipitated as lead salts. Furthermore, a resinous substance contain-

ing much oxygen was formed. Chem. Zent., 95, II, 1420.

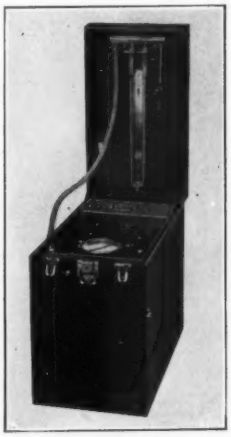
* * *

Determination of Gasoline in Moist Natural Gas.—The method for the determination of the gasoline and the moisture content of natural gas, which is described in Petroleum (German), 1925, page 1145, is one in which a known volume of the gas is passed through a tube which contains activated charcoal. The absorbed gasoline and water are subsequently expelled by heating the charcoal with cresol. Such a method was used and it has been found that it is liable to give a high value for the water content in the case of gases which contain much moisture, owing to the fact that the cresol is carried over with water during the distillation of the oil. This source of error is avoided by heating the charcoal with machine oil; that is, with compressor oil, instead of with cresol. A blank experiment is run in which a known volume of gasoline has been added to the oil, in order to ascertain that the oil is free from gasoline and water.

* * *

Cracking Oil and Chlorinating the Products.—In the journal, Helv. Chim. Acta., 1925, vol. 8, pp. 225-9, there is published an article in which there is described an investigation of the possible technical production of non-inflammable solvents by the combination of chlorine with the unsaturated hydrocarbons which are obtained when petroleum is cracked.

American kerosene, with a boiling



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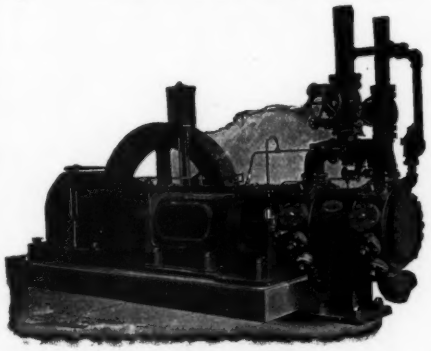

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point between 163 and 300 degrees C., a density of 0.8121 (at 21 degrees C. referred to water at 4 degrees C.), was passed over iron turnings in an iron tube which was heated at temperatures varying from 550 to 800 degrees C. The yield of olefines was greatest at a temperature between 650 and 675 degrees C., and at that temperature 30 cubic centimeters of the kerosene gave about 13 liters of gas containing about 30 per cent by volume of these compounds.

By passing chlorine into the gas as it was formed, maintaining a slight excess, in diffused daylight (ultraviolet light or the presence of a catalyst does not improve the yield), about 57 per cent of the gas was converted into a mixture of chlorinated hydrocarbons. This on distillation gave fractions which distilled at 65 degrees to 100 degrees C., 70.69 per cent chlorine, density 1.2464; from 100 to 125 degrees C., 73.41 per cent chlorine, density 1.3266; and from 125 to 150 degrees C., 75.14 per cent chlorine, density 1.3963. These were mobile fluids, with flash points 5 degrees, 19 degrees and 36 degrees, respectively. They readily dissolve sulphur, iodine and white wax. Chlorination of the original kerosene yielded a viscous, unstable liquid.

* * *

Determination of Lead in Gasoline.—Methods were examined which are intended for the determination of lead tetraethyl in gasoline. Lead may be detected by burning the spirit in a lamp with a one-millimeter wick and condensing the vapor on a water-cooled surface. For the quantitative determination of lead, the gasoline is heated with sulphuric acid and sodium nitrate or potassium permanganate, and the lead sulphate is separated and weighed. For further details, the reader is referred to Z. Nahr. Genussm., 1925, vol. 49, pp. 173-178.

* * *

Distilling and Cracking Petroleum Oils.—In distilling or cracking tars, petroleum oils and the like, the liquid is evaporated while falling as a sheet or curtain in front of electric or other heaters. The heaters may be electric resistances which are arranged in tubes of porcelain, pipeclay, quartz, and other suitable materials, or metal tubes which are traversed by hot gases, a molten metal, such as lead, or a molten salt, such as sodium chloride.

The unvaporized liquid falls through a sieve, which separates and is then recirculated. Vapors pass through perforated trays which are formed of catalytic metals, such as copper, nickel, cobalt, etc., which may contain purifying agents such as bauxite, quicklime, iron oxide, calcium chloride, and the like. Water, steam or gas may be passed into the apparatus. (British patent No. 224,497).

Lesh Plant in Receivership

Wichita, Kans.—With the naming of Dan F. Callahan, president of the Central State Bank of Wichita, as receiver, the plant of the Lesh Refining Company at Arkansas City may soon be back in the operating list. Liabilities against the property are said to be $130,000.

The Lesh refinery was built in 1914 by A. J. Lesh, who, with the assistance of his son, Lloyd Lesh, built it up to one of 2500 barels daily throughput.

Later the property, with 12 bulk stations in Kansas, was sold for $375,000. It remained under other management until 1921, when a loan made to the controlling concern provided that Lloyd Lesh return as manager. He held it for a year and then leased it for a year. A deal to buy it failed when the price was raised.

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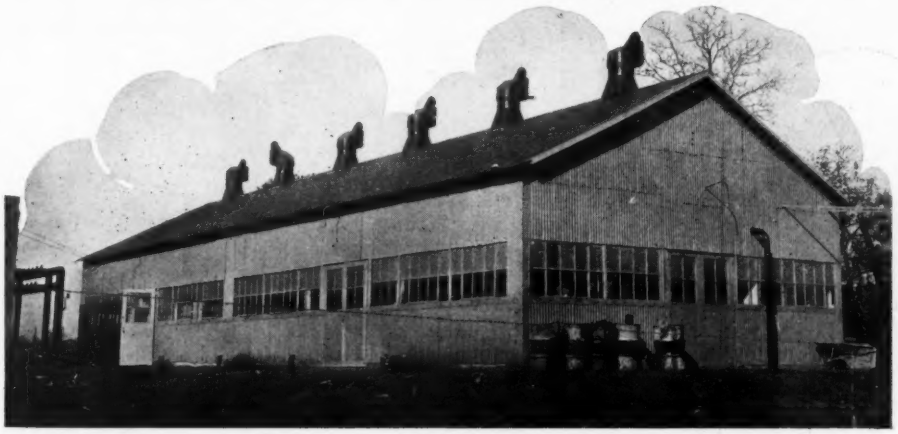

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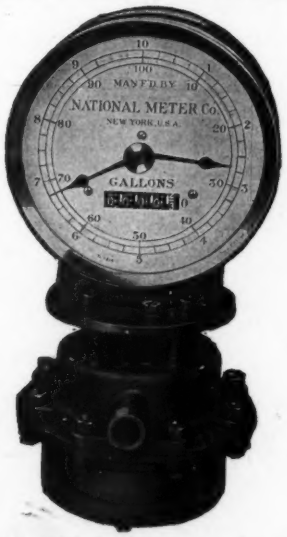

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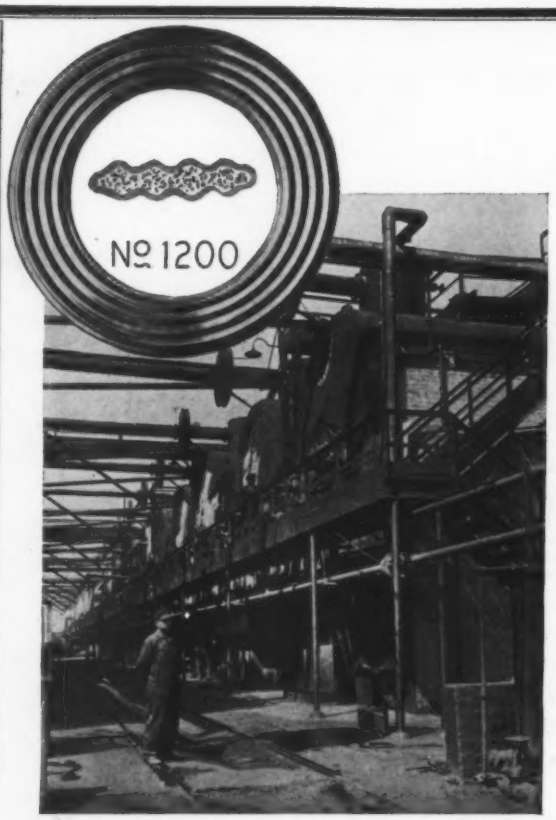

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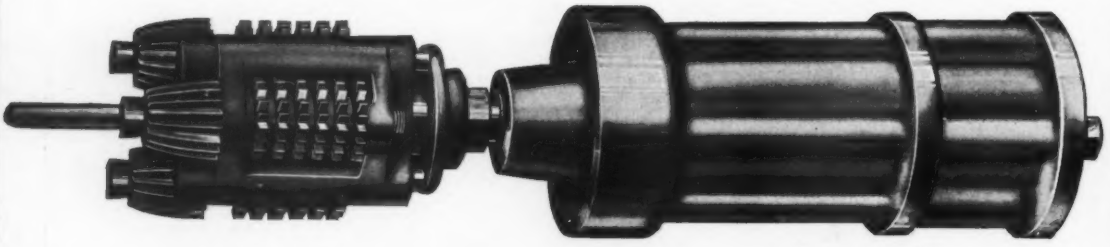

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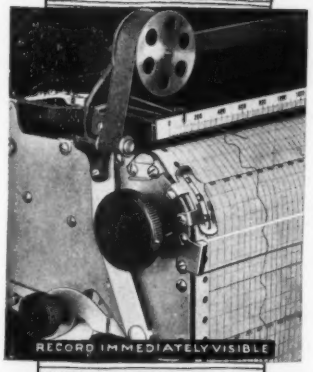

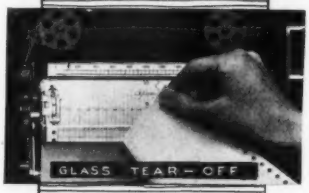

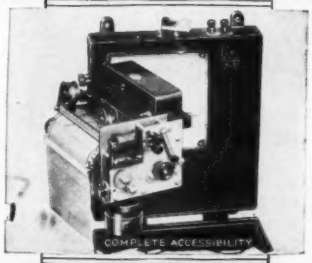

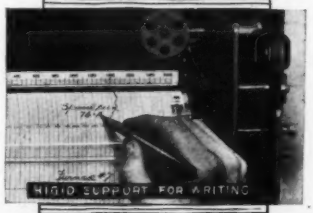

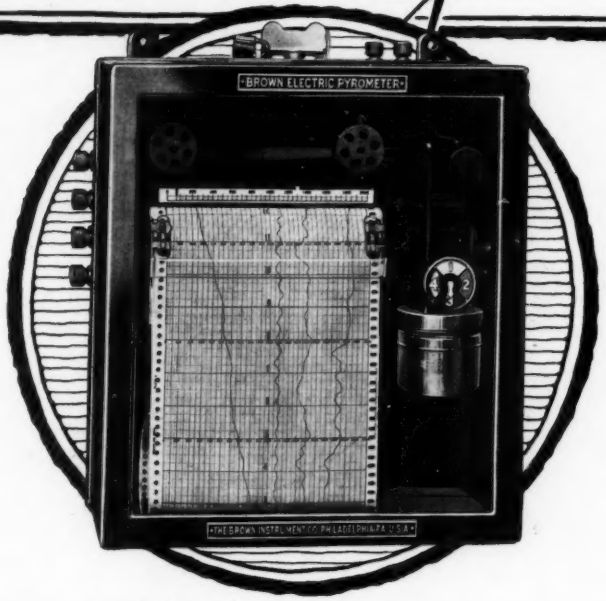

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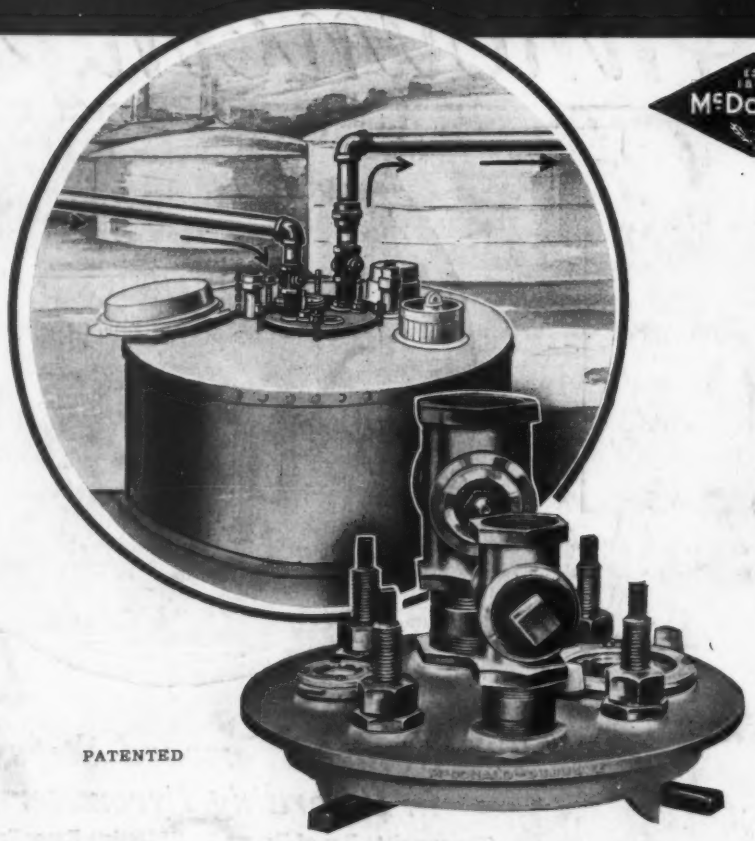

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